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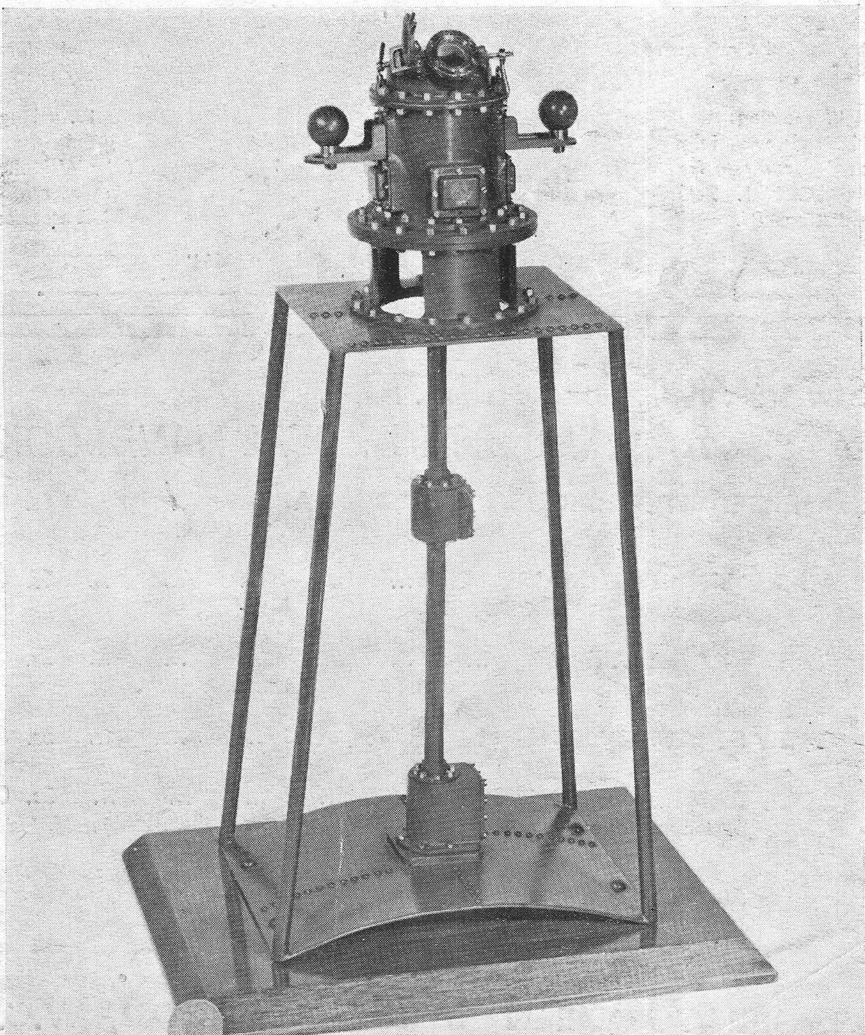
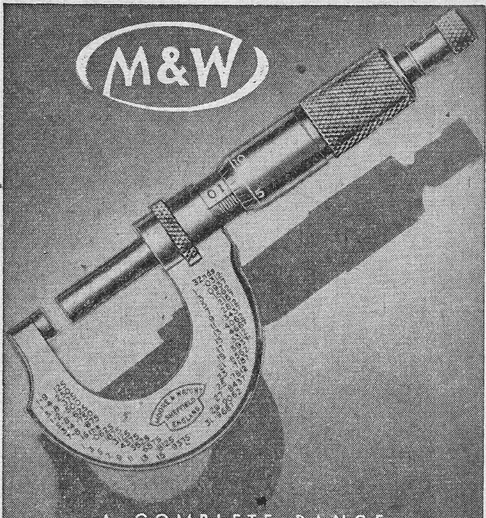
THE MODEL ENGINEER

Vol. 94 No. 2341 THURSDAY MARCH 21 1946 6d



The first of its kind? See "Smoke Rings"



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THE MODEL ENGINEER

Vol. 94 No. 2341 | Percival Marshall & Co., Limited Cordwallis Works, Maidenhead | March 21st, 1946

Smoke Rings

This Week's Cover Picture

SUBJECTS for cover pictures, apart from the requirements that they should be striking and attractive, as well as lending themselves to being photographed from a viewpoint that will give a print the right shape to fit into our present cover design, should, wherever possible, show a model that is in some way unusual. One such caught the eye of Mr. J. N. Maskelyne when he was inspecting the excellent display of models organised by the Romford Model Engineering Club at its "house-warming" party held earlier this year. In all probability, the model is the first of its kind to be made, and is certainly the first to be seen in public. It was made for demonstration purposes by Mr. S. Whatling, foreman of one of the workshops of Messrs. Henry Hughes and Son Ltd., the well-known makers of nautical and aeronautical instruments and apparatus, and is a scale replica of a Submarine Projector Binnacle. The workmanship is of a high standard, and all relevant detail is faithfully reproduced. The photograph was procured through the kind offices of Mr. K. B. Smith, secretary of the Husun Sports and Social Club.

Model Engineering in Bombay

IN spite of the disturbances in Bombay which have recently caused so much destruction and alarm, the model engineers of that city seem to have been able to carry on their hobby in a peaceful and enterprising fashion. In January they staged a most successful exhibition, their third annual show of the kind, which attracted no less than 5,000 visitors, and received the personal commendation of the Governor of Bombay, Sir John Colville. The exhibition was held in the Conference Hall of the Bombay Electric Supply and Tramways Company, at Colaba, and was open for twelve days. The exhibits covered all sections of model engineering and metal and wood handicraft, and were mostly the work of young Indians. An attractive feature of the show was the Denby and Cape Orange model railroad, an "O" gauge lay-out in full operation. This occupied a space of 12 ft. by 6 ft., and the rolling stock included two American "Prairie" type locomotives and one Diesel-electric Union Pacific streamlined articulated train, with a number of coaches and freight cars. Among the engineering models were the chassis for a 7$\frac{1}{4}$-in. gauge "Royal Scot," a "Green Arrow" 2-6-2 engine, and a "Flying Scotsman." Three narrow-gauge locomotives in $\frac{1}{4}$-in. scale aroused much interest. Modern aircraft were represented by a five-foot model of an air liner, complete with internal fittings and lighting, and a variety of gliders. In the ship modelling section the Chairman of the Society, Mr. M. P. Polson, took the first prize for a well-made steam launch. Altogether the show was a highly creditable effort on the part of the Bombay Society of Model Engineers, and bore adequate testimony to the enterprise and skill of its members.

A Sheffield Exhibition

I HEAR that the Sheffield Society is planning a representative exhibition for Easter week on April 24th to 27th, inclusive. It will be held at the Central Technical College, and entries for the competition and loan sections are now invited. Forms and all particulars may be obtained from Mr. A. F. Clayton, 76, Trafalgar Street, Sheffield. The Society's multi-gauge track will be in operation on behalf of a local charity, and other attractions will include compressed-air driven models and the Society's "OO" gauge lay-out at work. Co-operation is expected from other local societies representing aero and ship modelling and model yachting, so a good all-round display is in prospect. All the models on show will be insured.

Model Car Racing in the U.S.A.

SOME interesting news of a new model car-racing track at South Bend has just reached me from Mr. S. A. Walter, who passes on the details he has received from his friend, Mr. Joe Streburger. The new track is built to accommodate three cars racing abreast without cable control. It is 110 yards in circumference, on the centre line, is oval in shape, and is banked 75 degrees on the turns and 15 degrees on the straights. At a recent meeting, members from Chicago, Milwaukee, and Jackson (Mich.) were invited, and a record speed for this type of track of 82 m.p.h. was obtained. This is a high figure for free running cars, but is some way short of the 116 m.p.h. speed which has been achieved by cars running with cable control on an open track. The racing of three cars abreast, however, adds considerably to the spectacular interest, and no doubt the present record will be beaten in due course.

Percival Marshall

On Exhibitions in General— and One at Luton in Particular

By S.G.

WE, that is, The Vauxhall Motors Recreation Club Model Engineering Section, having held a successful exhibition of members' work in 1944, had ambitions to hold a bigger and better show in 1945. We considered the problem and decided that support from other local societies might be forthcoming for a joint effort.

The George Kent Model Engineering Society, The Luton and District Model Aeronautical Society, and the famous Aylesbury Gang, were all approached, and all promised support. The next step was to form a joint exhibition committee who got to work in no uncertain fashion.

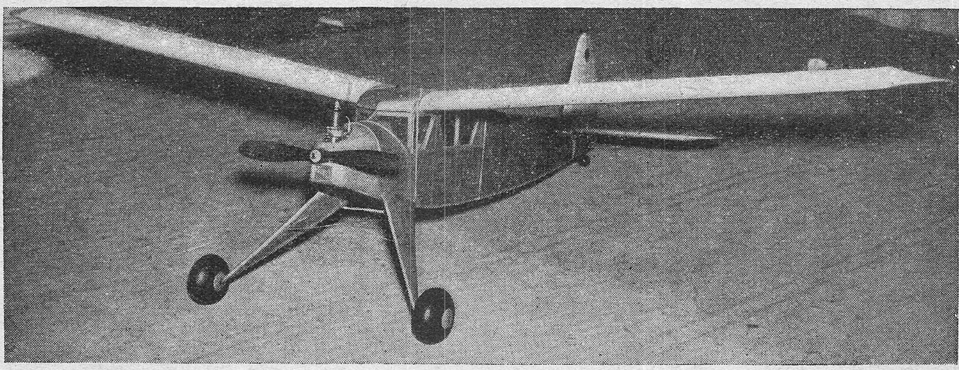
We hired the Winter Assembly Hall, Luton, for a week, and after several weeks' of hectic work, opening day arrived, and the attendance was well below what we had to average to meet expenses.

The visitors expressed their approval of the exhibition in no measured terms, but it looked like being a financial flop. By Thursday things were looking up, and Saturday we were packed. Actually 7,500 people saw the show. We had many distinguished visitors, Sir Charles Bartlett, managing director of Vauxhall Motors, Commander Kent, of George Kent's, Mr. Maskelyne, of THE MODEL ENGINEER, Mr. Crebbin, Mr. Westbury and Mr. Ward, being just a few of them.

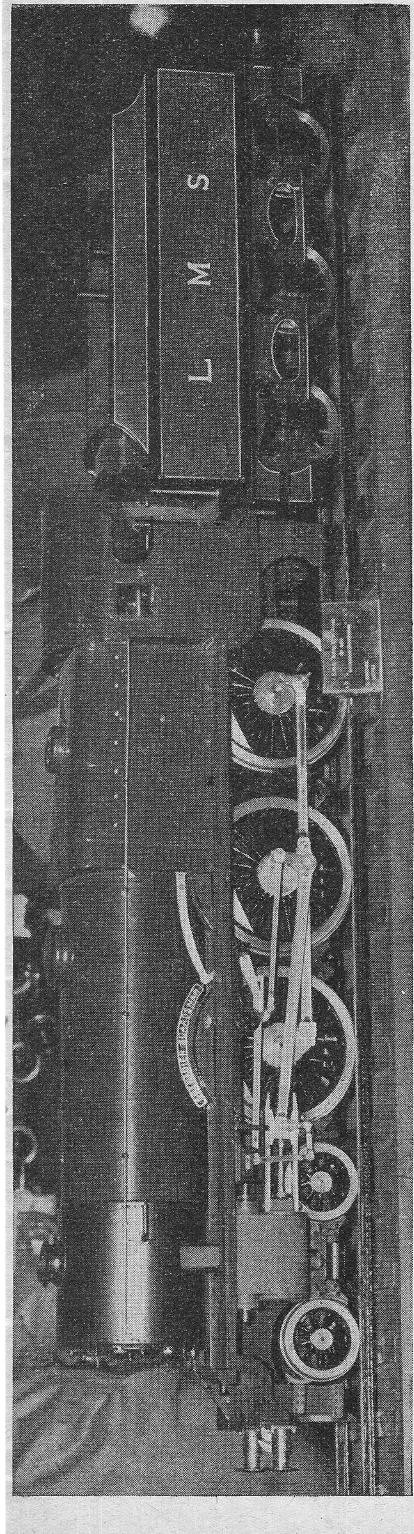
The respectable total of 243 exhibits was reached. Our local societies put up a good show, particularly the Aylesbury Gang, small in numbers but mighty in achievement. Mr. A. Woodward's beam engine, which won a MODEL ENGINEER championship cup in 1932, was undoubtedly the star turn. Mr. E. W. Fraser showed an Elizabethan ship, and a ¾-in. scale G.W.R. "Single," which were typical of his craftsmanship. Mr. E. G. Eborn brought over his 5-in. gauge "Halton Tank," and he and Mr. Dawson Bond did the lion's share of the work on the passenger track, kindly loaned by The Society of Model and Experimental Engineers.

Incidentally, Dawson Bond's L.M.S. mixed traffic 4-6-0 runs as well as she looks. She hauled eight adults on test. Our Vauxhall Section Secretary, Mr. Jim Temple, must have lifted quite a few tons of kiddies on and off the riding trucks, also loaned by the S.M. & E.E.

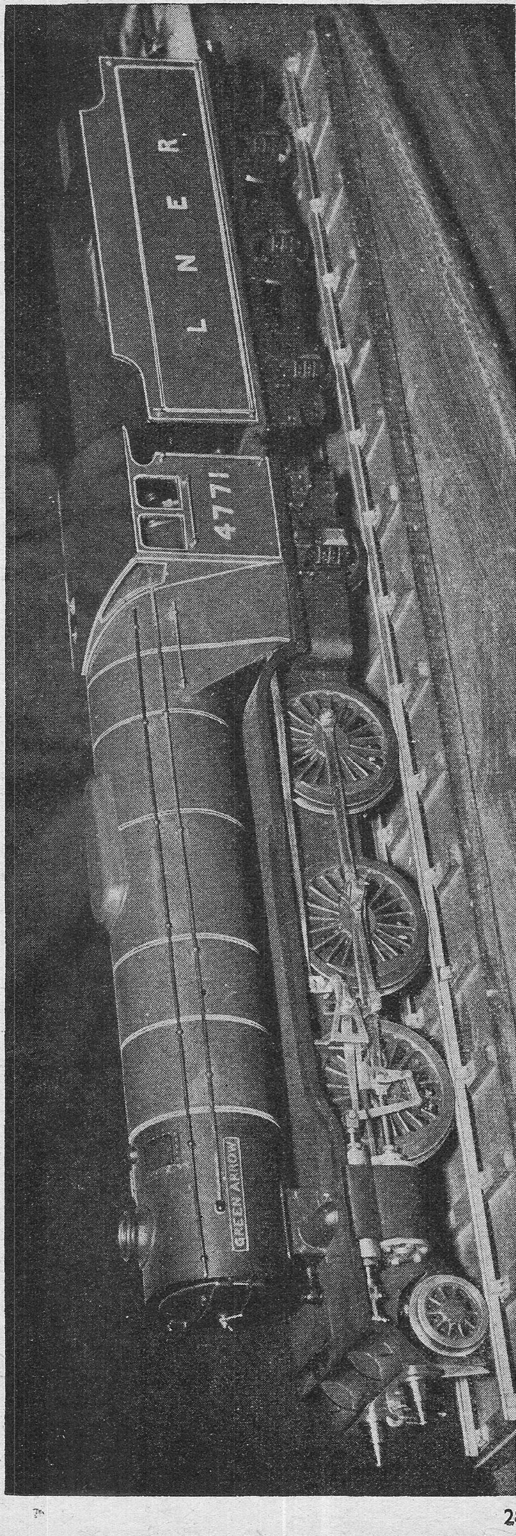
We have come to expect a very high standard of work from Mr. J. Hellewell and Mr. N. Boero, well known to readers of THE MODEL ENGINEER, but some of the exhibitors less well-known showed some beautiful work. Mr. Gurteen, of the George Kent Society, showed a model of a large type liner, 700 ft. in length, quadruple screw. This model, which was constructed entirely of paper, has taken nine years of the builder's spare time up to date. It is a truly marvellous piece of work, the amount of detail accurately modelled being nothing short of amazing. Mr. George Archer, the George Kent Society chairman, showed a nearly completed ¾-in. scale "Royal Scot"—a very nice job. The Terry's, father and son, members of the George Kent Society, showed some fine examples of partly completed locomotives. The quality of the work in the Aeronautical Section was excellent. No one could fail to appreciate the beautiful quality of Mr. Miller's workmanship. Some of the larger models were most impressive. Mr. D. McAlpine's petrol-driven plane, which has won many prizes in competitions, was a most impressive job. The Society of Model and Experimental Engineers, at very short notice, put up an excellent exhibit, which included two of Mr. Crebbin's famous locomotives. We were nobly helped by the Watford Society and the Murphy Radio Model Engineering Society, both of whom sent interesting exhibits of very high quality. Mr. G. Preen, one of our members, showed two perpetual calendar electric clocks, which attracted a great deal of attention.



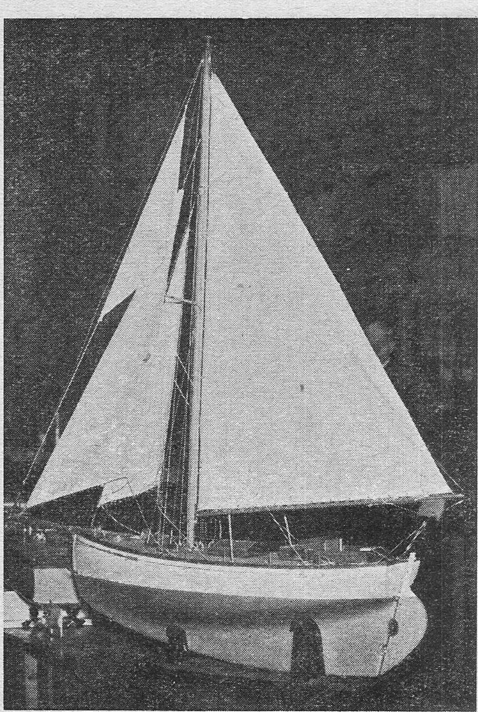
Mr. D. McAlpine's splendid 7-ft. span petrol-driven plane, designed by the builder, has won many prizes, including 1st at the Eastern Regional "Wings for Victory" Exhibition, 1943



A fine $\frac{3}{4}$-in. scale "Royal Scot" by Mr. Geo. Archer, chairman of the George Kent Model Engineering Society



Mr. Trefenbock's $2\frac{1}{2}$-in. gauge "Green Arrow"



This splendid model of a Falmouth Quay punt was completed by Mr. G. Barnard Baker, of the Murphy Radio Club, from the builder's half model of the original yacht

Some most fascinating demonstrations of glass blowing were given by Mr. J. Lyttleton, of George Kent's. His skill in manipulating glass was truly amazing, and the performance was rendered possible by the loan of an air compressor by the Murphy Society, who also gave some fascinating demonstrations with their large gyroscope.

The trade was well represented. The leading local ironmongers, Messrs. Gibbs and Dandy, had a fine display of tools and materials suitable for model engineers, Luton Model Aero Suppliers had a fine display on the stage which attracted a great deal of interest, and they could supply many items of use to the model 'plane enthusiast.

Excellent sample display tables carried specimens of the finished work and castings sold by W. J. Bassett-Lowke and Co., The East Kent Live Steam Co., Mr. D. Simmonds and Mr. W. H. Haselgrove.

No description of our joint exhibition would be complete without a word about the lady helpers, who did yeoman service issuing tickets at the door.

A Few Impressions

First, the very favourable comments by experts and general public alike.

Second, the orderliness and honesty of the crowds; there were only two cases of minor damage, and one of petty pilfering.

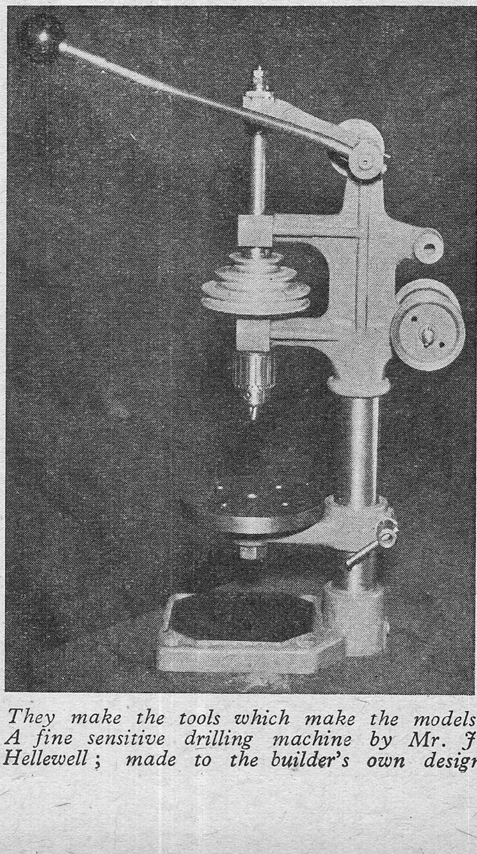
Third, the amount of smoke a 5-in. gauge locomotive can make during steam-raising operations.

Fourth, the marked effect on junior members' work of the excellent workshop provided by Commander Kent for the George Kent Model Engineering Society.

Fifth, the colossal amount of work involved in organising a show of this kind. Well, we've reversed the order of our title, but here are a few of the things that need looking after if you are interested in organising model engineering exhibitions in general.

(1) Hire your hall and get the regulations governing its use. (2) Beg, borrow, steal, or as a last resource, hire your display tables. (3) Arrange full insurance cover for (*a*) exhibits; (*b*) third-party risks. (4) Advertise by streamer, poster, slides in cinemas, advertisements in THE MODEL ENGINEER and local paper, stickers on car rear windows, and word of mouth, and remember that American adage "He who hollers down a well about the goods he has to sell will never make as many dollars as he who climbs a tree and hollers." (5) Chase every owner of an interesting model you can contact, make sure his property is properly identified by entry form and label, and finally show it with a printed and typed caption card, with all interesting information about the exhibit on it.

(*Continued on page* 288)



They make the tools which make the models. A fine sensitive drilling machine by Mr. J. Hellewell; made to the builder's own design

Petrol Engine Topics — By E. T. WESTBURY

*Methods of Making Crankshafts

IN most small engines which employ a simple overhung crankshaft, the machining of the latter from a solid bar is quite an easy job, involving little trouble in the way of marking-out. My usual method is to cut the bar to overall length, with trimming allowance, and to mount it in the chuck, with the full journal length projecting (Fig. 6). The end is then centre-drilled, and the back-centre is run up to support it during the roughing-down of the journal, the surface of which should be left fairly smooth and *dead parallel*. The shaft is then reversed and held by the roughed-down portion, which should be set to run truly, and as much as possible of the unwanted material around the crankpin removed by boring and turning at this setting. (Fig. 7.) At the same time, the throw radius can be marked out on the face of the disc, using a point tool set at the throw radius by measurement from the lathe centre. By scribing a complete circle on the disc with this tool, the measurement may be checked by a pair of dividers set to twice the throw. Any point on this circle may be used as the crankpin centre, so long as any marking-off of lines for cutting away crank-webs or balance weights are related symmetrically to it. While the work is held in the chuck, it should be centre-drilled sufficiently deeply to enable the shaft to be mounted between centres for finishing the journal, after the disc has been cut away to form the crankpin.

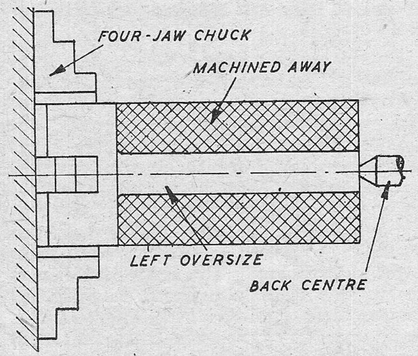


Fig. 6. Procedure in machining overhung crankshaft from solid round bar: first operation—roughing down main journal

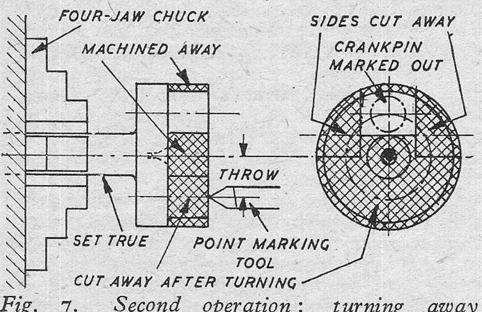


Fig. 7. Second operation: turning away superfluous metal from crank disc, marking out position of pin, and sawing away further unwanted metal

Before mounting the shaft eccentrically for turning the pin, most of the metal around it can be cut away with a hacksaw. The method of setting-up for crankpin turning (Fig. 8) will depend upon available facilities; I have described the use of a special socket fixture and also a Keats vee-angle plate for this purpose. Another idea is to use a chuck with its back-plate removed, and mounted eccentrically on the face-plate. Whatever method is used, however, it is most essential to ensure that the journal is held parallel with the lathe axis, and not tilted in any way. The use of a vee-block mounting has the advantage that its squareness with the face-plate can be very easily checked; but it will only hold the shaft truly if the latter is dead parallel over the length in contact with the vee-surfaces.

In all the examples of crankshafts shown in the figures, design has been reduced to its simplest form, and the journals of the shafts are shortened to reduce space; the proportions should, therefore, not be taken as ideal, or even necessarily correct in practice. Many shafts have stepped or tapered ends, with screw-threads for retaining nuts; the journals, webs, and crankpins may have to be drilled to form oil passages; and it is frequently necessary to undercut the webs behind the balance weights, so as to enable the weight of the latter to be increased without widening the distance between main bearings, as the latter should always be as close together as practicable. The general procedure, however, can usually be arranged to conform with the principles illustrated.

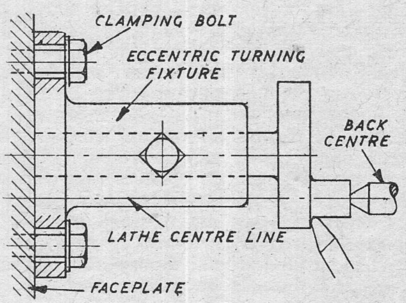


Fig. 8. Third operation: main journal held in eccentric turning fixture for machining crankpin

The material used for making a crankshaft should always be above suspicion as regards

* *Continued from page* 243, "*M.E.*" *March* 7, 1946.

soundness, and where mild-steel is used, the hot-rolled or "black" variety is preferable to bright rolled. Bessemer or special axle-steel is still better. It is desirable, if not absolutely essential, to normalise the metal, by heating to redness and allowing to cool naturally, before machining; and if special alloy steels are used, the heat-treatment recommended by the makers should be faithfully carried out. As few amateurs have facilities for heat-treating steel, I generally advise the use of common steels or "mild" (non-quenching) alloys which do not need special treatment.

Before dismissing the subject of machining crankshafts from the solid, a few comments on the problem of making hollow crankshafts may be useful. It is often desirable to bore out the centres of the main journals and also the crankpin, not only in order to combine lightness with strength, but also to form lubricating passages; but the task of carrying out this work sometimes proves to be a formidable problem, or at least may be regarded as such by the inexperienced machinist.

The drilling of a concentric hole through the main journals of a crankshaft should not be a very difficult operation. One end of the shaft may be held in the chuck, with the usual precautions to ensure true running, within close limits, while the other end is supported by some form of fixed steady. If the standard form of fixed steady is not available, a temporary substitute which is quite effective for all practical purposes, may be improvised. A rectangular bar of brass, gunmetal or cast-iron, about twice as wide as the diameter of the shaft at its projecting end, is held in the lathe tool-post, square with the running centre-line, and is then drilled and reamed from the lathe chuck to a neat fit on the shaft. Without moving the cross-slide, the saddle is then run back to the required distance from the chuck to support the end of the shaft, which should be kept well lubricated, as it is desirable to run it at high speed for efficient drilling. In most cases it will be found best to drill one journal at a time, reversing the shaft end for end for the second journal; but in multi-throw crankshafts, the drill will obviously have to run through one or more throw gaps to drill the inner journals, and there may be some risk of it running out of truth in these journals unless great care is taken. A sound way of ensuring proper guidance for the drill in this case is to use an undersize drill for the initial drilling at the end journal, and use the next size larger drill to follow up and start the hole in the next journal. Sharp and correctly-ground drills are essential for work of this nature.

Drilling the crankpin is by no means an easy job in the case of shafts turned between centres. A rather delicate setting-up operation is generally involved, and may necessitate the use of a vee angle-plate or an eccentric turning fixture, as illustrated in Fig. 8. Of course, when the crankpin is machined by the aid of such a fixture, no second setting-up operation is necessary. Double-bearing shafts, however, often present problems in centring and starting the drill truly, especially when the throw of the crankpin is short, so that the normal form of centre-drill cannot be used.

In most of my engines which are fitted with full cranks, I have avoided using concentrically bored crankpins, which are liable to be more trouble than they are worth. From the point of view of weight reduction, and more particularly the elimination of unbalanced weight, a hollow crankpin is highly desirable, but unless very large diameter pins, which allow of correspondingly large bores, are used, the amount of weight which can be saved in this way is extremely small. Constructors of two-stroke engines, who are always very much concerned about conserving crankcase clearance, may find bored crankpins and main journals undesirable, unless they are blanked off by plugs or caps afterwards.

Machining Crankshafts from Forgings or Castings

The general procedure in machining crankshafts in this class is not materially different from that employed for those made from solid bar, except that it is often necessary to provide some means of supporting the shaft on the crankpin centres, in the absence of special provision in the design of the rough component.

A few words about the respective merits of shafts in this class, and those made from the solid, may be appropriate. Theoretically, at least, it is better to forge a crankshaft than to cut it from a solid bar, because the "grain" or fibre of the metal will follow the contour of the webs and crankpins, instead of being crosswise in the webs, as when made from rolled or drawn rod. Exactly how much this advantage amounts to in practice, when using modern homogenous steels, is not quite certain; careful tests made on large aircraft and automobile engine crankshafts tend, I believe, to support the belief that there is something in it, but on the other hand, some engines which hold a high reputation for reliability have had crankshafts cut from the solid.

A more tangible advantage, from the point of view of the user of a light lathe, is that a forging leaves much less metal to be hogged out, though even in this case, there is often a lot of metal left on to cover possible inaccuracy in truth or dimensions, and the presence of hard scale makes machining much more troublesome than cutting from a clean bar.

Comparatively few amateur constructors attempt the hand-forging of crankshafts, though there is much to be said for this practice, if only to keep alive the almost-forgotten, but very worthy, art of the old-time blacksmith. Drop-forged crankshafts have sometimes been supplied with sets of parts for constructing engines, though the expense of forging dies usually deters the model supply trade from indulging in such luxuries. A potential advantage in using drop-forgings is that the makers are usually engaged in similar work for full-sized engines, and are thus able to supply the special alloy steels which have been found most suitable for crankshafts, many of which work just as easily while hot as the common or inferior steels. But one cannot rely on this advantage unless

the dealer is willing to disclose who actually makes the forgings—on which subject, I find, his lips are usually discreetly sealed.

I once machined up a forged crankshaft which was claimed to be made of 3 per cent. nickel-steel—a material which, as most engineers know, is highly suitable for crankshafts of fairly high duty, and should machine readily. It is quite possible that this shaft may have contained the specified percentage of nickel all right—but they omitted to mention what percentage of horseshoes, gaspipe and old bedsteads it contained as well! The cost of the forging was about seven-and-sixpence, I believe—but the cost of the tools worn out in machining it, not to mention time and temper, many times exceeded this modest figure.

In large engines, a special technique has been evolved in making hollow cast crankshafts, in which the grain flow of the metal is the nearest practical approach to the ideal, in its property of resisting the particular stresses encountered.

The use of the electric furnace has also facilitated the casting of mild- or alloy-steels, with the certainty that their essential properties will be retained, instead of being affected by the chemical properties of the fuel or its products of combustion in the older cupola or open-crucible processes. Model engineers may not, at the moment, be able to avail themselves of these up-to-date developments, but I have been watching them very carefully for many years, and in cases where it has been possible to make tests, and confirm the advantages of such materials, in their application to model work, I have recommended them to the attention of the model trade.

I have used "Meehanite" crankshafts in small stationary engines with complete success; in one of these, an overhung crankshaft was used, cast to shape, including the balance-weight, so that only the bare minimum of machining work was necessary, and no subsequent heat-treatment was carried out, though it could have been used to increase strength and hardness.

Some years ago, I succeeded in obtaining a casting in stainless-steel for a small crankshaft, which was used by the late Mr. F. Ford and myself in experimental work on one of his

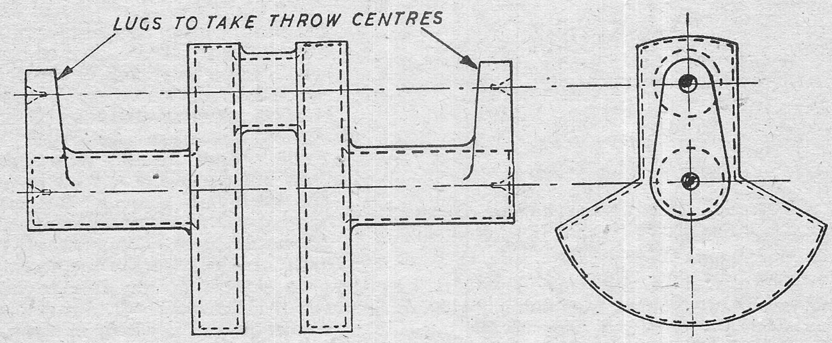


Fig. 9. A forged crankshaft equipped with lugs at each end to take centres for turning the crankpin

Cast Crankshafts

The idea of a cast iron crankshaft may sound somewhat startling to many model engineers, and, of course, ordinary cast-iron is a most unsuitable material to withstand the torque and shock encountered in a petrol engine. But in recent years, research in ferrous metallurgy has enabled founders to produce materials such as "inoculated" or alloyed iron—one of the best examples of which is that known as "Meehanite"—which are suitable for use as crankshafts in their initial cast state, and can be further improved by suitable heat-treatment so as to rival the best alloy steels for this purpose.

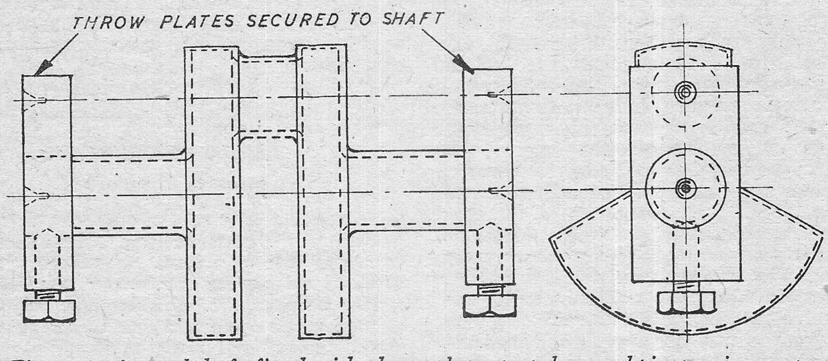


Fig. 10. A crankshaft fitted with throw plates to take crankpin turning centres

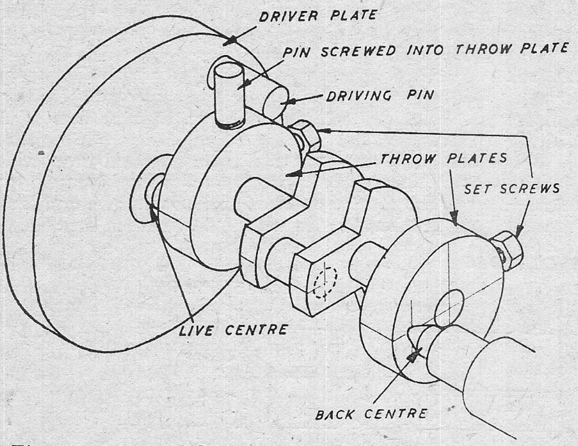


Fig. 11. A crankshaft set up on crankpin centres by the aid of circular throw plates, showing a convenient method of driving

engines. The results in this case, however, were somewhat disappointing. Machining of the journals and crankpin were fairly straightforward, but drilling the oil passages was a difficult operation, owing to the work-hardening properties of the material. If the drill point became dulled or ceased cutting for any reason, the bottom of the hole burnished, and the drill would run almost red-hot in a few seconds. The job was, however, accomplished by using drills of 18 per cent. tungsten steel. But although there was never any occasion to doubt the mechanical strength or soundness of the finished crankshaft, its wearing properties proved to be very poor, and the crankpin, in particular, scored badly and persistently in spite of forced lubrication.

Mention may be made of the use of malleable cast-iron. This material has somewhat similar mechanical properties to wrought iron, including a higher ductility and tensile strength than ordinary cast-iron. It has been used in the past for low-duty crankshafts, such as in certain types of steam engines and air compressors. Several years ago, I tried out this material for crankshafts of small two-stroke engines, but the results were very disappointing. It appeared to be liable to serious cracks, especially at changes of section, such as the shoulders of the main journal or crankpin with the web, and to distortion after machining ; also, for some reason, the castings were extremely rough and inaccurate, calling for an abnormal machining allowance and involving considerable wear on tools. These objections may not apply to all malleable castings, but the experience deterred me from exploring this particular field more completely.

Machining Procedure

Crankshafts made either by casting or forging processes may with advantage be equipped with projections or lugs on the ends of the main journals, which extend radially in the same plane as the crank throw, so that they can be marked out and centre-drilled for mounting the shaft to turn the crankpin. A shaft thus equipped is shown in Fig. 9. In the case of multi-throw cranks a disc flange should be formed at each end, on which all throw centres may be set out. This is particularly useful in the case of steam engine crankshafts, in which the eccentrics are also to be machined integrally.

Where throw lugs are not incorporated in the crankshaft forging or casting, it is necessary to make separate throw plates or discs, which are temporarily mounted on the ends of the journals, after roughing down the latter. They should be a good fit, and must be very firmly secured, as any shifting in the course of machining would result in serious inaccuracy of the parallel alignment of the crankpin. In modern practice, the use of hardened socket screws of the Allen type is recommended for this purpose, as they have ends specially shaped to bite into the shaft and provide the maximum security ; but where ordinary steel set-screws are used, it is advisable to drill-sink the shaft to take the screw points. Needless to say, it is advisable to leave the shafts well oversize when the throw-plates are fitted, so that in the finishing of the journals, screw-marks or depressions may be machined out.

In some cases, where throw-plates have been used in the manufacture of crankshafts in full-size practice, standard plates, having throw centres already set out and drilled, are employed ; these are located either by means of a surface gauge on the marking-out table, or by some form of alignment jig. But for "one-off" jobs, it is better to secure the throw-plates to the shaft before marking-off, and to proceed exactly as in the case of solid crankshafts, or those having integral throw lugs. This enables the risk of errors in lining-up the throw-plates to be eliminated, or at least much reduced, and if it should be found desirable to use the same throw-plates a second time, there is a choice between working from the old centres or setting out new ones.

(*To be continued*)

Luton Exhibition

(*Continued from page* 284)

(6) Arrange a duty rota of stewards, drivers and helpers on the passenger track, and ladies taking cash and issuing tickets. (7) Check electricity supply available for compressor motors, steam-raising blowers, etc. (8) Arrange transport for all models and equipment that have to be collected and delivered, and give the driver a clear list, with up-to-date addresses, and have a man who understands handling models with him. (9) Arrange for coal, oil of the correct varieties, soft water, and above all, a barrier to keep the crowds back if you are going to operate a passenger track. (10) If you are going to sectionise your exhibition (and we think it's the right idea) get some good large clear notices and suspend them where they can be seen. (11) Allow plenty of circulating area just inside the entrance. (12) Get taxed admission ticket rolls where entertainment tax has to be paid.

High Speed Milling

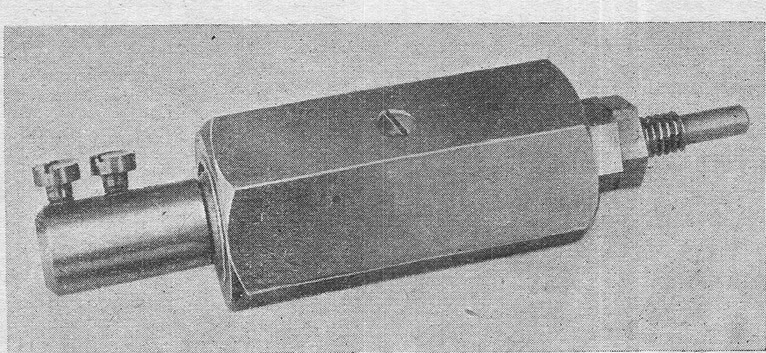
By M. A. MILLAR

As Applied to Small Locomotive Parts

IN the construction of my $1\frac{3}{4}$-in. gauge 4-6-0 locomotive, I have endeavoured to machine all surfaces of working parts for three main reasons. First, a properly-machined part will be more accurate to dimensions and have a nearer approximation in appearance to a full-size locomotive part than if it is filed to shape, unless a very great deal of time is spent on the job. Secondly, where parts have to be made in duplicate, any number can be produced by means of a jig, including spares which may be required in the future. Thirdly, the aim to machine a part fully in the lathe adds a new zest to the work, and encourages one to devise new ways of avoiding labour at the vice and a great deal of dull monotony with hand tools.

Where, of course, a workshop is equipped with a variety of accurate machine-tools, including milling- and planing-machines, there is every incentive to produce a high standard of work; but, in my own case, I possess only a treadle-driven lathe of very doubtful accuracy and rigidity, and it merely continues to function so long as the tools are kept razor-sharp. The problem arose during the war when I desired to machine the outside faces of my locomotive cylinder blocks, with the valve-ports, exhaust passages, and sundry parts of the motion, and any appliances for this work were impossible to obtain at that time. The tool which would fulfil my need was a small milling-spindle, which, running at a very high speed, would impose small loads on work (brass, gunmetal, etc.) mounted in my lathe; and it could be very sensitively applied for depth and range of cut in various planes of movement.

The sketch (Fig. 1) shows the small but simple milling-spindle I made to overcome this deficiency in my workshop, and it is driven by an 80-watt electric motor and flexible shaft drive, which I acquired for a small sum just before the war. I have no idea as to what the



The hexagonal body of the milling spindle can be held very conveniently under the tool-post

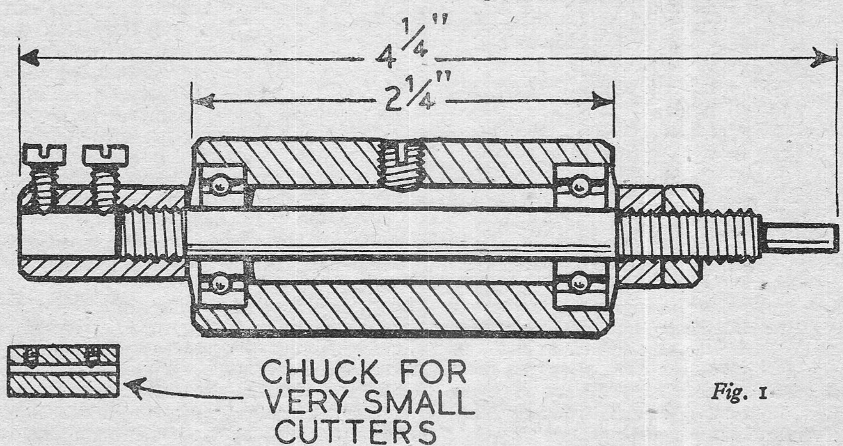


Fig. 1

motor was originally designed for, but it turns over at such a high speed that the cutter in the spindle appears as just a blur, with the metal chips coming off in a stream, similar to a miniature wood saw.

The body of the milling-spindle is made from a short length of $\frac{3}{4}$-in. hexagon brass, drilled and bored to take a pair of small ball-bearings fitted with dust-excluders, and with sufficient internal clearance for the spindle to provide an oil receiver. The chuck is a short piece of round mild-steel screwed $\frac{1}{4}$-in. B.S.F. and sweated to one end of the spindle, and is bored truly to take a $\frac{1}{4}$-in. diameter silver-steel cutter as a nice push fit. Two $\frac{1}{8}$-in. Whitworth screws are fitted in the chuck to hold cutters of various profile, and also a special baby chuck for cutters of $\frac{1}{16}$ in. diameter.

The tail-end of the spindle is threaded $\frac{1}{4}$-in. B.S.F. to take nuts for end adjustment, and is also reduced in diameter to accommodate the chuck fitted at the end of the flexible from the motor. A $\frac{1}{4}$-in. Whitworth grub-screw in the centre of the body allows a small amount of oil to be fed to the ball-bearings at intervals. Where it is not possible to fit a flexible shaft drive for this tool, a small pulley can be easily attached by the lock-nuts to the spindle tail, and a flat belt drive (thin leather belt $\frac{3}{8}$ in. or $\frac{1}{2}$ in. wide) taken to a motor mounted in a convenient position on an extension arm bolted to the slide-rest. The cutters used for brass, gunmetal, etc., are very similar in shape to an ordinary D-bit, except that they are well backed-off. An extraordinary variety of them can be filed from silver-steel, hardened, tempered and ground within an hour.

One of the first special jobs this home-made milling-spindle was put to was the profile milling of my gunmetal cylinder-blocks, so that the Russian iron lagging should fit closely over the cylinder-barrels and valve-chests. The diagram, Fig. 2, indicates how a cylinder-block is mounted on cones between the lathe centres and rotated by the faceplate so that the cutter of the milling-spindle machines the outer surface of the block circumferentially.

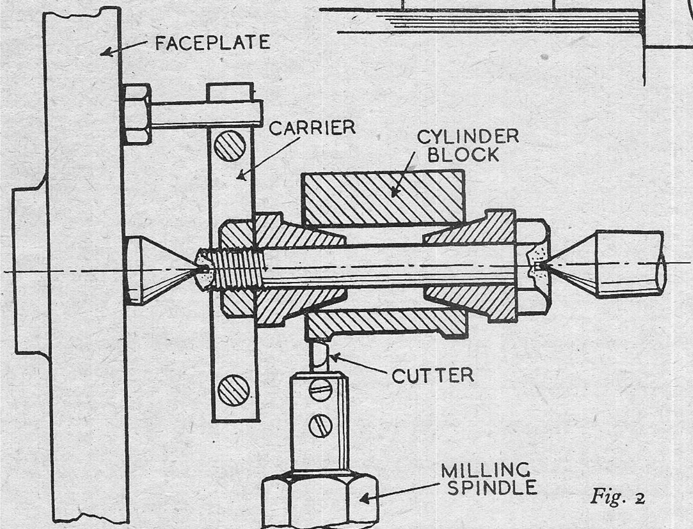


Fig. 2

The cones are turned from brass and bored a good sliding fit on a $\frac{5}{16}$-in. diameter bolt, so that when the nut on this bolt was tightened, the cones automatically centralised the cylinder-bore with the bolt and also provided sufficient grip to rotate the cylinder-block against the milling-cutter. The bolt was very carefully centred at each end to take the lathe centres, and a carrier, set to grip the nut on the bolt, engages a peg bolted to the faceplate, so that the latter can rotate the cylinder-block positively in both directions, no rotational float being allowed.

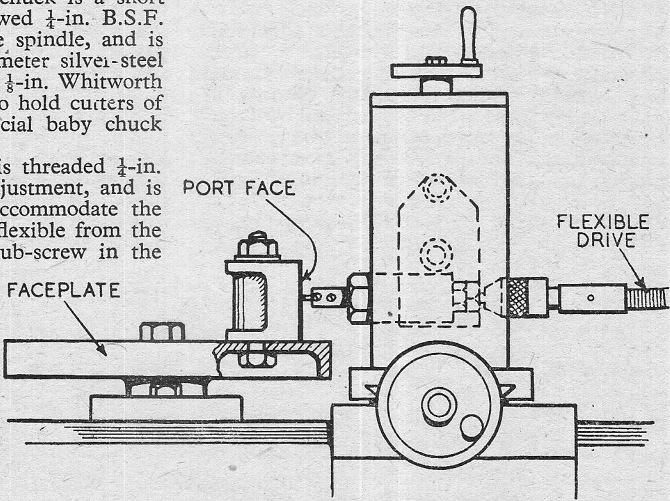


Fig. 3

When the milling-spindle is clamped under the tool-post (at lathe-centre height), the depth of cut is governed by the cross-slide movement, the side-to-side cut by the saddle (or top slide) movement. The range of circumferential movement is controlled by rotating the faceplate through the headstock back gear by hand, as between predetermined limits shown by scribed lines on the rim of the faceplate, the lines being read off against a stiff bent-wire pointer fixed to a convenient point on the headstock.

Very light cuts are taken, but a surprising amount of metal can be removed in a short time; and, if the job needs to be inspected away from the lathe, the fixture can be removed and replaced on the lathe centres without impairing the subsequent milling operation, provided that the carrier engages the faceplate driving-peg in its original position. The arrangement of the cones on the bolts allows, of course, for other

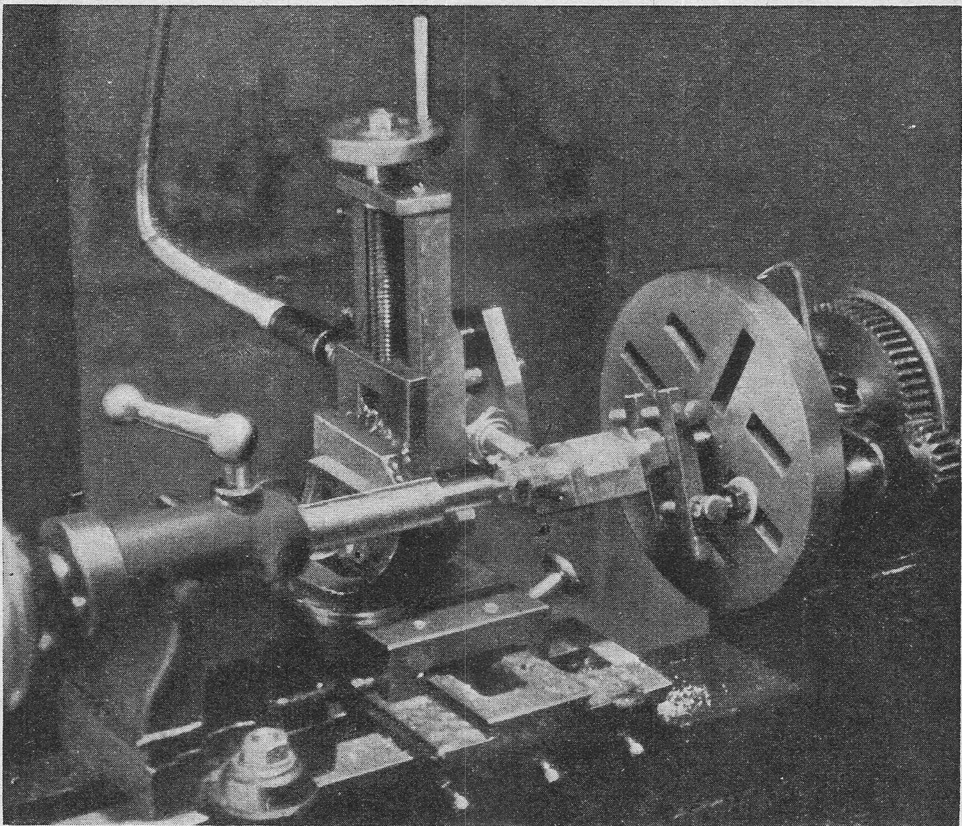
bored jobs being conveniently mounted between centres for milling purposes.

Fig. 3 indicates the lathe set-up in which the steam and exhaust ports of the cylinders were accurately cut by a $\frac{1}{16}$ in. diameter end-mill in the milling-spindle clamped under the tool-post of the top slide, the latter being set up as a vertical slide by means of an angle-plate bolted to the slide-rest saddle.

The cylinder-blocks were bolted side-by-side to the faceplate, which, in turn, is secured to the lathe-bed by stout parallel cross-bars and bolts and nuts. The faceplate, in this position, acts as a very convenient slotted platform for any job that has to be set parallel with the cross-slide, and converts the lathe into a very useful milling machine on a miniature scale. Readers may enquire as to why the job was not bolted in the normal manner to an angle-plate on the faceplate mounted on the headstock nose; but too much complication would arise in setting the angle-plate parallel with the bed transversely, while some means would have to be devised to prevent the slightest rotational movement of the faceplate.

If the cylinder port-faces are scribed off clearly, a spotlight directed on the work, and a magnifying-glass temporarily held to the vertical slide by a wire support, the milling can be operated to produce most neatly and accurately cut ports, and to a depth ample for most cylinders. Afterwards the ports are squared off at the ends with a Swiss file.

On locomotives of "O" and "1" gauges, the making of the various parts of the motion requires a very great deal of handwork and patience, especially in regard to the rounded ends of the coupling- and connecting-rods, and the bits and pieces of the valve-gear. In a two-cylinder 4-6-0 model having Walschaerts valve-gear, there are no fewer than thirty-two of these rounded ends of rods to be filed up, ignoring any finesse in the matter of oil-cup bosses and special detail in design that gives the model the correct "scale" appearance.



The milling spindle set up in the vertical slide for profile milling of cylinder blocks

To overcome the tedium of hand-filing these items and to produce a proper machined finish to these rod-ends, I devised the simple jig illustrated in Fig. 4, whereby the rod (previously marked-off and drilled to dimensions) could be end-milled to the exact diameter required and radiused on either side in a few minutes. The jig is gripped under the tool-post, and is fed to the end-mill, held in the headstock chuck, with a light cut, cutting oil being applied with an occasional drip from a small brush. If the

lathe is not motor-driven, and the right speed is not available for a fly cutter, then very good results can be obtained by using one of the latest high-speed end-mills having four cutting edges. I have a set of H.S. double-ended milling-cutters, ranging in diameter from $\frac{1}{8}$ in. to $\frac{1}{4}$ in., and they will last a very long time in machining the relatively small pieces of mild-steel used on my locomotive.

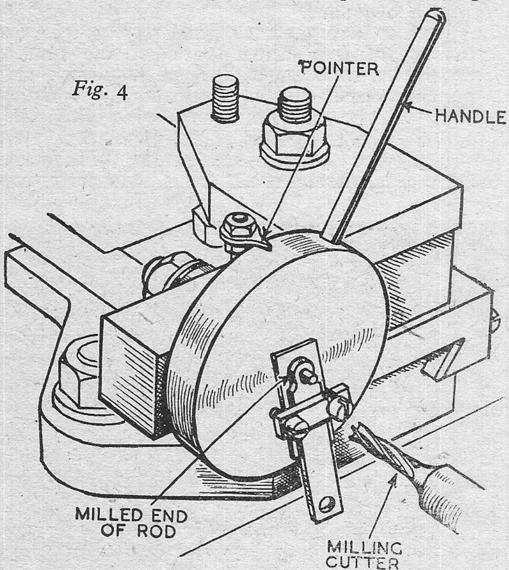


Fig. 4

The construction of this jig is very simple. A thick brass disc, 2 in. diameter, is screwed and sweated to a $\frac{1}{4}$-in. diameter spindle, which passes through a drilled reamed hole in a $\frac{3}{4}$-in. square brass-bar (Fig. 5), of sufficient length to allow the bar to be securely held under the tool-post or clamping-plate on the slide-rest. The rear end of the spindle is threaded to take a $\frac{1}{4}$-in. Whitworth nut, and between the nut and bar is fitted a stiff spring washer to provide frictional resistance to rotation of the disc against the bar. The other end of the spindle projects $\frac{1}{4}$ in. from the face of the disc and is turned down to 3/32-in. diameter, and an accurate fit for 3/32-in. reamed holes in the ends of pieces of strip-steel to be milled in the jig.

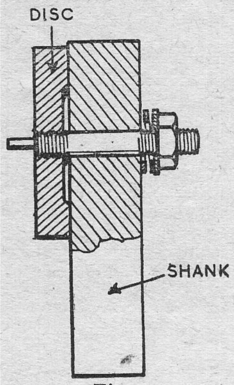


Fig. 5

A small cross-bar, of $\frac{1}{4}$-in. $\times$ $\frac{1}{8}$-in. flat steel, drilled with clearance-holes to take a pair of $\frac{1}{8}$-in. Whit. screws, threaded in tapped holes in the disc, hold the piece of steel to be milled firmly on the 3/32-in. spigot. A number of $\frac{1}{8}$-in. holes can be drilled and tapped at various centres in the disc to take cross-bars of varying lengths for the accommodation of all sorts of shapes of metal for special purposes. A $\frac{3}{16}$-in. steel rod handle is screwed into the periphery of the disc; its length should be such that a complete revolution could, if necessary, be given to the disc without the handle fouling the lathe-bed. In the top face of the bar behind the disc is a short $\frac{1}{8}$-in. steel rod upright fitted with nuts to hold a small pointer which projects slightly over the outer face of the disc, but clearing the handle when the latter is rotated.

The operation of the jig is as follows. The coupling- or connecting-rod to be machined is marked-off, drilled and reamed 3/32 in. on a flat piece of steel. One end is pushed on to the spigot in the centre of the disc against a strip of aluminium previously drilled and placed in position, and the cross-bar screws tightened. The jig is then brought up to the milling-cutter and a " sight " taken of the distance as between cutter and spigot to produce a given diameter to the end of the rod. This distance is adjusted by movement of the cross-slide. Again, a " sight " is taken to ascertain how much rotary movement of the disc is required (Fig. 6) to mill right round the end of the rod from one side of the neck to the other, to register with the scribed lines on the work. When this has been carefully done, pencil-marks are made on the rim of the disc opposite to the two positions shown by the pointer.

The work is fed into the milling-cutter by small cuts after each rotary movement of the disc, and provided that the pencil marks on the discs are methodically observed, a superbly finished end is given to the rod, which will

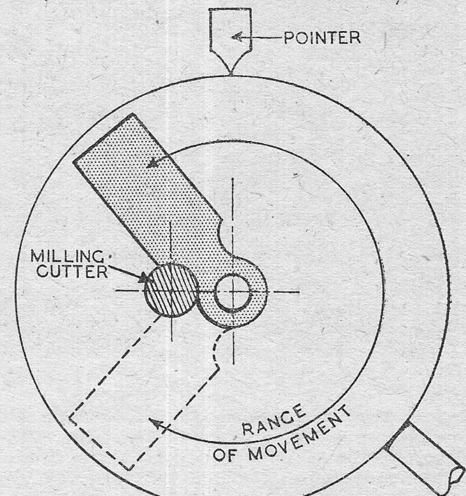


Fig. 6

require no treatment with a finishing-file or even smooth emery-paper. Two or three rods can be fed on the spigot and clamped together; thus perfectly duplicated ends can be produced in one operation. The function of the aluminium strip is to prevent the cutter chewing various slots in the brass disc and spoiling the bedding face for

(*Continued on page* 296)

"Hielan' Lassie" By "L.B.S.C."

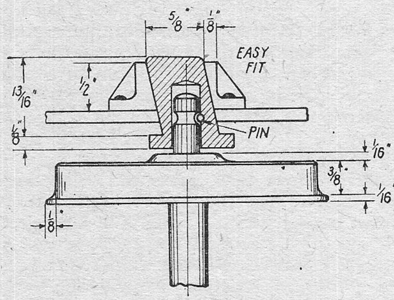
A $3\frac{1}{2}$-in. Gauge L.N.E.R. 4-6-2

"THE best-laid plans o' mice and men gang aft agley," wrote Bobby Burns. So does your humble servant's, on occasions! A case in point was in the trailing-axle arrangement for the "Lassie," and, incidentally, it illustrates another example of the trials and tribulations that have to be put up with, in scheming out a little locomotive for a real job of work. As the curves on the average garden line are usually laid to a radius that would be impossible on any full-size main line in this country, and even fairly tight for colliery or works sidings, where no main-line engine ever penetrated, the wheelbase of the little sister has to be made flexible enough to take sharp curves; and for that reason I proposed to specify something that the full-sized engine does not possess, *viz.*, a fully-guided radial axle. A tentative sketch of a nobby arrangement, very similar to the Webb radial axle, was made, and I was just congratulating myself on being able to please our old friend Inspector Meticulous at last, when I suddenly realised that the faceplate of the average small lathe wasn't big enough to allow the curved guides to be set far enough away from centres, to be machined to the correct radius. That put the "tin lid" on my fancy axle right away; and I was compelled to revert to a simpler wheeze which was a favourite of the late Mr. Steadman Jackson, and which I have used with variations on my own engines. It is shown in the accompanying illustrations.

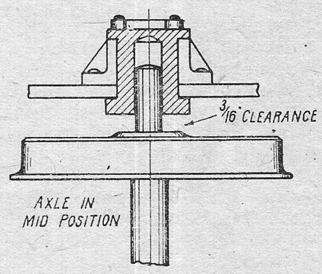
Instead of the jaws between the horncheeks being machined out square with the frame, they are cut on an angle. If separate cast side-frames are used, with the horncheeks and dummy springs cast integral. the openings could be milled out, if a regular-milling machine is available, by catching the frame upside down in the machine vice on the miller table, and slewing the vice around, so that the whole issue could be run at the correct angle (12 degrees) under a side-and-face cutter on the arbor. That is how I should do it myself. Same process could be repeated on a lathe, if the saddle is low enough to admit the job; otherwise the vice would have to be bolted to a vertical slide, and the job done with an end-mill in the three-jaw. If a one-piece casting is used for the whole cradle, or if it is made from steel plate, the horncheeks (with or without dummy spring) would have to be riveted on first, and then the openings machined, so that the cast or plate frame slots would line up correctly with those in the horncheeks. If no means of machining are available, the only thing to do is to file the openings by hand, using a piece of bar about $\frac{5}{8}$-in. by 1-in. section, as a gauge; this should fit easily. It doesn't matter about the angle of the jaws being exactly the same as shown in the illustration; a shade more or less will not affect the working, but both sides must be at the same angle. After machining or filing one side, bend two little bits of strip metal to the angles, one acute and the other obtuse, and use them as gauges when the other side is tackled.

Radial Axleboxes

The axleboxes may be either cast or machined from bar. If castings are used, the pair will be cast end-to-end, and there will be no real need for machining, as the rebates can be cleaned up with a file until they fit easily between the horncheeks. The face and the back can also be filed smooth. For the sake of appearance a dummy lid may be made from sheet metal, and attached by a couple of round-head screws; or maybe this will be cast integral, and will save work. The position of the axle hole is important in the radial boxes; both must be drilled exactly the same, or the boxes will bind in the horns. Mark-off a point on the back of each box, $\frac{5}{16}$ in. from the bottom, and $\frac{3}{8}$ in. from the acute angle side; drill a $\frac{1}{4}$-in. clearing hole to a depth of $\frac{5}{8}$ in. This hole must be at right-angles to the back of the axlebox; if you have a drilling-machine, put the axlebox in the machine-vice, gripping by top and bottom, so that the back is level with the tops of the jaws. Then go ahead and drill, using letter "F" or $6\frac{1}{2}$-mm. drill. If only the lathe is available, the machine-vice must be held against a drilling-pad on the tail-stock barrel. Young Curly made a machine-vice from two bits of angle-iron cut from a broken bedstead rail, and two long stove-bolts; and wasn't he proud of it! "Every cloud has a



Radial axlebox



Plain axlebox

silver lining," says the old proverb; and the advantage of being desperately poor is that, if you need anything, you just have to make it, and so gain experience, or go without. Had I been born in the lap of luxury, these notes would never have been written. Kismet! However, returning to the job, mark-off the position of the pinhole on the top of each box; but before drilling, put a piece of $\frac{1}{4}$-in. brass rod in the axle-hole, then drill through the lot, letting the drill go clean through the box from top to bottom; the pinhole should just cut through the side of the axle-holc. The reason for the pin is, that if the journals were free to move endwise in the axleboxes, the latter would not slide between the horns, remaining still whilst the axle did the sliding. A groove is turned in each journal, and the pin works in it; therefore, as the axle cannot move endwise without the boxes following suit, the latter naturally cause the axle to make a radial movement corresponding to the direction of the curve, which eases the flange friction and makes for free running.

The axleboxes can also be made from 1-in. by $1\frac{1}{4}$-in. brass bar, either cast or drawn, so long as the brass is of good quality. Either a regular milling-machine, or the lathe, can be used to mill the rebates that slide in the horn-cheeks, the process being the same as described for main axleboxes; a piece of metal sufficient for the two boxes is clamped under the lathe tool holder, or held in a machine-vice on a vertical slide, and the $\frac{1}{8}$-in. rebate taken out with an end-mill in the three-jaw. To get the required angularity, all you have to do is mill or file away the parts shown shaded in the detail sketch. Drill for axles and retaining-pin as described above, and ornament the front with a dummy lid, or crossbar, or anything else you fancy.

Springing

The illustration shows the assembly of the trailing axleboxes and springs with a dummy spring cast integral with the frame; but the working spring and plunger in the buckle or hoop is the same, whether the spring is cast on, or a separate casting attached to a one-piece cast cradle, or to a built-up one. For the sake of appearance, the spring pins are not cast on, but made and fitted separately, just as if real working leaf spring were used. The lugs will be cast on the frame, and these and the ends of the dummy springs should be drilled No. 30, care being taken to get the holes dead in line, so that the pins are vertical. The pins themselves may either be turned from $\frac{5}{16}$-in. rod to the shape shown, or made from $\frac{1}{8}$-in. rod with a separate top. For the latter wheeze, chuck a piece of $\frac{5}{16}$-in. mild-steel rod in the three-jaw, face the end, centre, and drill down $\frac{1}{2}$ in. or so with a 3/32-in. drill. Turn two reversed cones as shown, and part them off. Turn down the upper end of each pin to a drive fit in the holes in the top pieces; drive them in, and slightly rivet over. The lower ends of the pins are reduced to 3/32 in. where they project below the lugs, and furnished with a commercial nut and washer.

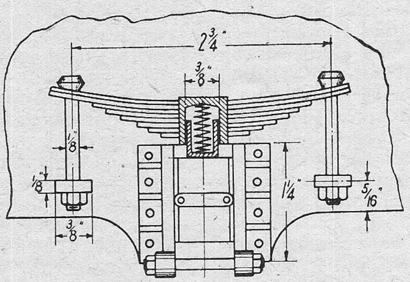
Separate cast springs for attachment to a one-piece cast frame, or a "fabricated" steel plate frame or cradle, will have a hanger and pad cast on at each end; so all that has to be done with these, is to rivet them in place, taking care that the spring hoop comes exactly over the centre of the axlebox. The hoop of a cast spring should be centre-punched exactly in the middle, and a blind hole drilled in it $\frac{3}{8}$ in. diameter, penetrating as far as you can go, without breaking through, say $\frac{7}{16}$ in. To make the plunger, chuck a piece of $\frac{3}{8}$-in. round steel rod in three-jaw, and take a skim off it, so that it slides easily in the hole in the spring hoop. Face the end, centre, and drill down with $\frac{1}{4}$-in. drill for $\frac{5}{16}$ in. depth; part-off a full $\frac{3}{8}$ in. from the end, reverse, and chamfer slightly. If the parting-tool has left a pip in the middle, face it off, as the end of the plunger must be quite flat where it rests on the axlebox. Assemble as shown; the boxes cannot fall out of the horns when the engine is lifted, because of a bolt passing through the two lugs cast on the bottom. They should be drilled No. 30, and the bolt made from a piece of $\frac{1}{8}$-in. round steel, shouldered down to 3/32 in. at each end, screwed and furnished with ordinary commercial nuts; see illustration.

If anybody likes to take the trouble to make them—they are worth doing—real working leaf springs may be fitted in place of the "ersatz" specimens. The best way is to use Mr. Glazebrook's system of laminated plates, which combines correct massive appearance with requisite flexibility. The plates are not solid, but each one consists of three or four thin leaves, held by a clamp screw in the usual hoop or buckle. In the present instance, the two top plates of the Gresley-pattern spring are of equal length; so to simulate them, six leaves of spring steel, about 28-gauge, $3\frac{3}{16}$ in. long, and $\frac{3}{8}$ in. wide, would be required, having $\frac{1}{8}$-in. holes punched in them at a full $2\frac{3}{4}$ in. centres, for the spring pins. Each plate below, would need three leaves to give required thickness. The whole lot would be fitted in a hoop made from $\frac{1}{2}$-in. square brass or steel rod, which should be chucked truly in the four-jaw, faced off, and turned to $\frac{3}{8}$ in. diameter for about $\frac{1}{8}$ in. length. Centre. drill No. 40 for about $\frac{1}{4}$ in. depth, and tap $\frac{1}{8}$-in. or 5-B.A. Part-off at $\frac{1}{2}$-in. from shoulder. Cross-drill $\frac{3}{8}$ in. and file the hole square to take the plates. An Allen screw is the most satisfactory for clamping the plates in the hoop, but an ordinary grub screw, or a countersunk screw, may be used instead. The spring pins and lugs are exactly the same as first described for the cast-on spring, and the assembly is also the same, except that instead of the spring pins passing through clearing holes in the lugs, the latter are tapped, the pins screwed into them, and the nuts act as locknuts. "Tugboat Annie's" trailing springs are made and fitted in similar manner, and work perfectly, giving a beautifully smooth-riding engine which does not derail.

Alternative Sliding Axle

If any builder of the "Lassie" doesn't fancy the radial axleboxes, he can use the ordinary type, and make the axle slide sideways to provide the necessary flexibility on sharp curves. In this pattern, the openings between the hornchecks

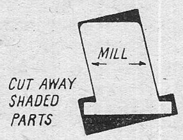
are milled or filed at right-angles to the sides of the cradle, and ordinary double-flanged axleboxes are fitted to them. These axleboxes are made either from castings, as supplied for "Bantam Cock" (plenty available) or from $\frac{7}{8}$-in. square brass or gunmetal bar, the process being exactly as described for the coupled axles; the dimensions are given in the accompanying illustrations. Each box is drilled to a depth of $\frac{3}{4}$ in., with $\frac{1}{4}$ in. clearing drill, at a point $\frac{9}{16}$ in. from the top, on vertical the centre line; the holes must be square with the back of the box. When fitting the boxes to the horns, allow them a weeny amount of tilt; they should slide easily, but not enough to rattle. The retaining bolts, springing, etc., are all exactly the same as specified for the radial boxes described above. No vertical pins are needed; the ends of the axles are turned to a length of $\frac{11}{16}$ in., an easy fit in the holes in the boxes; and when the wheels are on, and the axle erected, same will be found to have $\frac{3}{16}$ in. side movement each side of central position. which will be plenty for all normal curves.



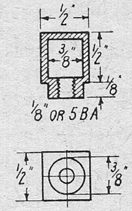
Trailing axlebox assembly

Wheels and Axle

The trailing wheels are $2\frac{3}{4}$ in. in diameter on tread, with flanges $\frac{1}{16}$ in. wide and $\frac{1}{8}$ in. deep, and are turned in exactly the same way as the wheels already described, so there is no need for repetition. They are drilled 19/64 in. and reamed $\frac{5}{16}$ in. The axles are turned from $\frac{3}{8}$-in. round mild-steel, also as previously described, both wheel-seat and journal being turned at the same setting; but the journals for the radial axle are only $\frac{9}{16}$ in. long, whereas those for the sliding axle are $\frac{11}{16}$ in. long. The ends should be slightly rounded. To find the position of the groove in the radial axles, put the box on, and keeping it pressed against the wheel seat, poke a No. 32 drill down the pinhole. This will make a little channel in the journal. After repeating the process with the second axlebox, chuck the axle in the three-jaw; and with a pointed tool, the end of which has been slightly rounded-off, turn a groove a full $\frac{1}{8}$ in. wide, and a full $\frac{1}{16}$ in. deep, at the location shown by the little channels. Press the wheels on; replace the axleboxes, and drive a piece of $\frac{1}{8}$-in. silver-steel into each pin-hole, filing off flush with the top of the axlebox. Any time that it should be necessary to take the boxes off the journals, knock the pin out from underneath. To assemble the lot, turn the chassis upside down, fit the springs and plungers, drop the wheel-and-axlebox assembly into place, and fit the hornstay bolts. The complete assembly should slide freely from side to side, and the wheels should spin freely in any position of the axleboxes. As the radial guides are straight, instead of being slightly curved as they would be in full size, a little play must be allowed between axleboxes and horns, to give the necessary freedom; on my own engines fitted with this type of axle, the



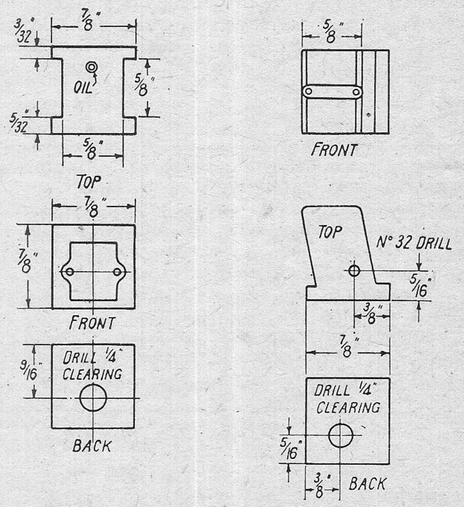
Radial box cut from solid



Hoop for built-up plate springs

boxes have not sufficient play to cause any rattle, yet they are quite free in any position, and have never derailed even when doing the equivalent of 100 m.p.h. around my south curve.

That completes the frames and running gear of the "Lassie"; so, if you have a railway of $3\frac{1}{2}$-in. gauge, take the chassis out and give it an introduction to its future sphere of activity; wheel it up and down a few times, and try it around the curves, to see that the coupling-rods do not bind, and the bogie and trailing axles perform their allotted functions. Should there be any fault, see that it is corrected right away



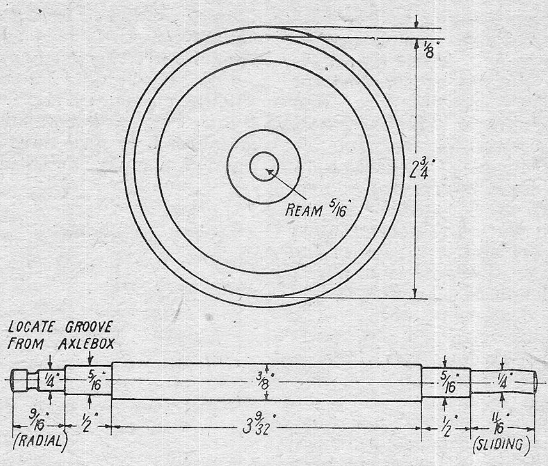
Alternative axleboxes—Left, plain; Right, radial

so that there is no going back and searching for tight places and other troubles, when the cylinders and motion have been erected. Next job, inside cylinder.

New Wine in Old Bottles

Going from one extreme to the other, here is an interesting echo of the dim and distant past. A reader, commenting on my recent notes on "Looking Back," says he unearthed an

ancient and dilapidated relic some time ago, and wonders if I could place it. The old iron is a six-wheeled single-wheeler of nondescript design and poor construction. The frame is a brass "bedplate" with a long rectanglar opening for the boiler, same being apparently made from a piece of brass tube with ends of bigger diameter soldered on; the end discs fit the ends of the opening, thus allowing the hot gases from the open-flame three-wick spirit lamp to pass up each side of the barrel. It has a long chimney going right through the barrel, two domes of unequal size, the larger one having a spring safety-valve in it, and a "squeaker" whistle, the handle of which projects through the weatherboard, a plain bit of sheet-brass with two holes in it for windows.



Trailing wheel and axle

The axles, which are only $\frac{3}{16}$ in. in diameter, run in brass bearings hanging down from the bedplate like stalactites; the wheels are spidery brass castings; leading and trailing $1\frac{3}{4}$ in. diameter, drivers $3\frac{1}{4}$ in. The brass slide-valve cylinders, the front covers of which are soldered on, are $\frac{5}{8}$-in. bore, $1\frac{1}{4}$-in. stroke, each attached to the bedplate by two 3/32-in. screws (!); valves are operated by loose eccentrics. The piston-rods are extended, and run through a bearing attached to the underside of the bedplate. A brass block is set-screwed to each piston rod, and from this block a strip of brass, with two right-angle bends in it, goes to each driving crankpin and acts as a connecting-rod. Leading buffer beam is wood, with two miniature drawer-knobs screwed in to represent buffers, whilst the drawbar is a cup-hook. There is no tender; a piece of brass, bent channel-shape and screwed to the back of the bedplate, acts as a sort of bunker, and prevents the engineman accidentally falling off. The footplate fittings consist of an angle-cock with a big handle attached to it, a pipe going from this cock along the bottom of the boiler to the cross pipe between the cylinders (aha! somebody knew about superheating, apparently) and a test cock half way up the barrel. The exhaust comes out below the cylinders, the two pipes taking hairpin bends into the chimney. The boiler will make enough steam to turn the wheels if jacked up, but she won't even pull herself. The gauge is 3 in. Our friend says he is tickled to death with the old crock, and would like to make it go, if possible.

Could I place it—bless your hearts and souls, if young Curly had owned one of those engines before he reached double figures, he would have been the proudest and happiest kid in the whole wide world. I saw plenty of them in Bateman's, R. A. Lee's and other shops way back in the 'eighties; it was a "standard" design, and persisted right up to the time when Stevens of Aldgate went out of business. I have the bits of one of the "very identicals" here right now, and hope to assemble them, plus a monkey-gland or two, just to show that the engines could have been made to do the job, of which more anon. Meantime, if our friend reams out the cylinders, fits new pistons, refaces the ports and valves, sets the timing with lead and early cut-off, adds a lubricator (plain displacement will do) and makes a shield of some sort to prevent any draught deflecting the lamp flames from the boiler, the ancient "Wheezy Anna" will probably surprise him, if she doesn't blow the ends of the apology for a boiler out and bend the brass connecting-rods. In fact, it would be a good plan, before getting up steam, to put a brass stay through the boiler, make a stouter pair of connecting-rods, and put four screws in each of the soldered-on front cylinder covers. Safety first!

High Speed Milling (*Continued from page 292*)

the rod-ends on the spigot, while the emergence of aluminium clips (as distinct from steel) notifies one that the milling of the rod is finished.

The light cuts of the cutter and comparatively short radial distance between cutter and spigot cause a very small rotational drag to be set up in the disc, and so a very small effort is required by the operator to turn the disc by the handle, except against the resistance of the spring washer on the spindle, which should be sufficient to act as a nice brake against the movement of one's hand. If heavy cuts (with a power drive) are indulged in, the milling-cutter will inevitably catch the edges of the strip metal and do a lot of damage. I chose 3/32 in. as the most convenient diameter for the bushed holes of my valve-gear. The diameter can be reduced to $\frac{1}{16}$ in., but the spigot should then be made from silver-steel; and, of course, the milling operations must be treated with corresponding delicacy and care, otherwise the rather delicate pin may be easily bent or broken off.

If the disc is clamped to the supporting bar, horizontal milling or slotting can be carried out on any work held under the cross-bar, within the limits of the jig. The slotting of valve-gear links, and drag beams for small locomotives, are other useful functions to which this jig may be turned.

Model Submarine Competition Result

We have pleasure in announcing that, after very careful consideration of all the eleven entries submitted, the following is the result :—

First Prize—Sub.-Lt. John Gray, of Dunoon, Scotland.

Second Prize—Mr. F. L. Davies, of Monkseaton, Northumberland.

Lt.-Col. A. G. Bates, the instigator of this interesting competition, has submitted the following critical comments upon the entries :

The entries fell into two groups according to principles employed to secure submergence. Firstly, those boats having always a small positive buoyancy and using hydroplanes suitably inclined in relation to the thrust of the screw to force the vessel under. These totalled seven. Secondly, those boats in which buoyancy was varied in order to submerge and did not use hydroplanes to overcome any remaining positive buoyancy. There were four of these.

For convenience these two groups will be referred to as F.P.B. (fixed positive buoyancy) and V.B. (variable buoyancy) respectively.

Depth Control

Only two competitors (one in each group) employed hydrostatic depth control, *i.e.*, where use is made of the change of pressure due to depth to actuate mechanism tending to keep the vessel at constant depth.

In each example the pressure sensitive device was a flexible membrane having water on one side and the hull atmosphere on the other.

In the F.P.B. example hydroplane settings were controlled using compressed air as motive power.

In the V.B. example, compressed air was used to expel water ballast whenever a fixed depth was exceeded.

The remaining entries in the F.P.B. group relied on finely adjusted hydroplane angles to produce a balance between the tendency to rise due to remaining buoyancy and the downward thrust due to the flow of water past the hydroplanes. Just why this balance should be maintained and hence depth remain constant is somewhat obscure, but in practice it can be done. It is easiest with very small values of remaining buoyancy and for shallow running and demands very steadily maintained propeller revs.

One entry in the V.B. group employed a ballast pump system intended to achieve neutral or negative buoyancy, in conjunction with cam actuated hydroplanes, the two sets of operations being synchronised. The pump system was unusual in that no valves were needed and nothing was pumped into or out of the ship. What happened was that the movement of the pump plungers altered the displacement of the boat by expanding or contracting the air space inside the hull. There seems no reason why this action should not be controlled hydrostatically, in which case the vessel could be made to hover between two limiting depths with engines stopped.

Hydroplanes

All competitors used them, usually two forward and two aft, interlinked and movable. Occasionally one pair was fixed and there was one example having a single hydroplane only situated in the propeller wake. Two boats in V.B. group used hydroplanes actuated solely by pendulums to assist longitudinal stability when submerged. One in F.P.B. group used a pendulum to vary the parallelism of forward and after sets of hydroplanes whenever the boat was not on an even keel.

Propulsion

Battery operated electric motor ..	7
Clockwork	2
Compressed air	1
Petrol engine	1

The electric drives, with one exception, were on normal lines. The exception was in F.P.B. group and employed a cam actuated sequence switch operating a series/parallel arrangement of cells whereby the boat used 8 volts for surface running and 16 for diving and running submerged, with consequent greater submerged speed and less inclination of hydroplanes needed to get below the surface.

The petrol-driven craft was the most intriguing design in the F.P.B. group. It resembles the final pattern of German submarine, in having neither batteries for electric propulsion submerged, nor a " Schnorkel " device for allowing an I.C. engine to breathe. However, since the engine is of normal type (a No. " 1831 " is specified) and not a chemical engine, it has to carry its combustion air in bottles and replenish supplies during periods of surface running. This severely limits the ratio of submerged to surface running. Compressed air is also used for all controls, and these are more complete than in any other entry. There is, however, quite a lot of experimental detail development needed before the design can be finalised.

Hull Design and Details

Nearly all entrants used metal hulls. Watertightness of hatches and glands was a weak point in some designs, and in no class of vessel is it so vital. Small submarines need a lot of adjustment and there is scope for much ingenuity in machinery arrangement to permit this and yet to avoid long watertight joints. There seem to be two alternatives to this problem. Either to design the vessel in two or three sections with circumferential joints, each section carrying its share of the doings and the units being provided with bolted connections, or some drawing together mechanism which clamps the midship section between the outer ones. Or, to group the gadgets needing attention, so that a reasonable number of small access hatches

(*Continued on page* 300)

Fixing Wood-Screws

By W. J. HUGHES

WHEN a Whitworth- or B.A.-threaded screw is being used to fix together two pieces of metal, one would not dream of attempting to drive it in without allowing clearance for the shank of the screw in the upper piece of metal. (See Fig. 1.) And the clearance hole would be a fixed size relative to (*i.e.*, slightly larger than) the diameter of the screw. Similarly, the tapping-size of the hole in which the thread was cut would be relative to the diameter of the screw, in that (theoretically) it would be equal to the core size of the screw. This term may be explained by imagining that a screw be turned down in the lathe until the threads only are turned away; then the " core " of the threads would be left, and its diameter would be the theoretical tapping-size for that screw. In actual practice, of course, the tapping-size is a little larger, for various reasons which need not enter into an article on wood-screws.

However, it is desirable to bear in mind this business of the " clearance " hole for the shank, and the " core-size " hole for the threaded part, since wood-screws require similar treatment.

How Not to Do It

It has not been unknown for a " handyman " (what a multitude of sinners is covered by this generic term!) to bore a hole with a handy bradawl or gimlet, insert therein the tip of a screw of much too large dimensions, seize a screwdriver, whose edge is burred over, and turn with great vigour until the screw refuses to go any farther. As this is usually about half-way in, he uses bad language, and persists in his efforts until the slot of the screw is neither use nor ornament, and the screw can be neither driven home nor withdrawn. So with battle in his eye, he seizes a " Brummagen screwdriver " (in other words, a large hammer) and literally drives the poor inoffensive screw home. Having relieved his feelings in this bestial manner, he looks round for another unsuspecting victim. Incidentally, worthy citizens of Birmingham, justly incensed at this calumny on the fair name of their great city, should remember that a hammer is also known as a " Manchester screw-driver," and fight it out with the Mancunians—don't write to the Editor about it. But that is by the way.

The Correct Way

Now if our hero (or villain—decide for yourself!) had gone the right way about it, this is what he would have done. Selecting a screw appropriate to the job, he would choose " clearance " and " core-size " drills appropriate to the screw chosen. The upper piece of wood would be drilled with the clearance drill, and the lower one to the correct depth with the core-size drill. If the upper piece of wood were fairly thin, it might be necessary to " clear " the top of the core-size hole (see Fig. 2). If a countersunk screw were being used, the clearance hole would be countersunk neatly with a rose bit, and then a suitably-shaped screwdriver used to drive home the screw, with no fuss and bother at all.

It should be remembered that the purpose of a screw is to cramp the two pieces firmly together, and the correct procedure will allow this, whereas if the " clearance " hole is a tight fit on the shank of the screw, or the " core-size " hole is too small, the worker will experience difficulty in sufficiently driving home the screw to ensure a tight joint.

On the other hand, of course, if the clearance hole be too big, accuracy of fitting will be sacrificed, and if the core-size hole be too big, the screw cannot cut a sufficient thread, and so will not grip.

Sizes of Screws

The table given herewith (Fig. 7) will enable one to pick out at a glance the correct sizes of drills for the more common of the various diameters of screws, which range, incidentally, from No. 00 to No. 20, so that for each length of screw there is a good number of different thicknesses obtainable. When buying screws, the appropriate thickness number should be quoted, *e.g.*, " 1 in. × 6, 1 in. × 8, $1\frac{1}{4}$ in. × 7, $1\frac{1}{2}$ in. × 10." The table does not quote for odd numbered sizes, but where these are concerned, the intermediate size of clearance hole may be used, with the next lower size of core-hole —*e.g.*, for No. 9 screw, the clearance hole would be $\frac{3}{16}$ in., and the core-size 7/64 in.

It is impossible to lay down hard and fast rules as to what size of screw is required for any particular job; when screwing wood to wood, the length of a suitable screw would be from two and a half times to three times the thickness of the top piece, if this is commensurable with the strength of the job and the thickness of the bottom piece. The diameter should also be so related. When hinges or other metal plates are being screwed to woodwork, this rule does not apply, of course, and one's own judgment must be used as to the strain on the screw or screws concerned. The following formula will give some idea of the resistance of *correctly inserted* screws in wood :—

$$f = d.p\,l. \times 42{,}000 \text{ for soft-wood, or by } 83{,}000 \text{ for hard-wood.}$$

f being resistance in lb., d the diameter of the screw, p the pitch or distance between threads, and l the length of the *thread* of the screw, all in inches.

From this it can be shown that a $1\frac{1}{2}$ in. × 10 screw should resist in red deal a force of over 500 lb., and in oak of nearly 1,000 lb., which isn't bad going for one screw.

The type most commonly used has a countersunk head, and the clearance hole should be countersunk at the correct angle of 45 degrees.

W. J. H.

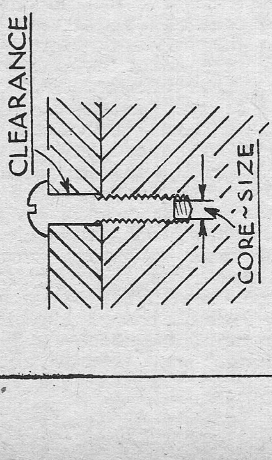


FIG. 1.

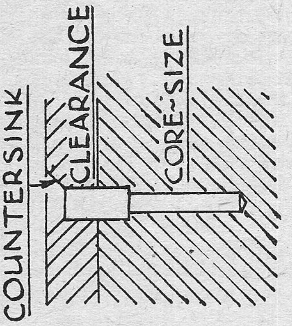


FIG. 2.

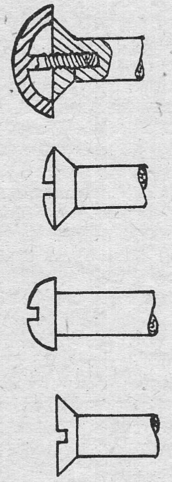


FIG. 3. TYPES of SCREW

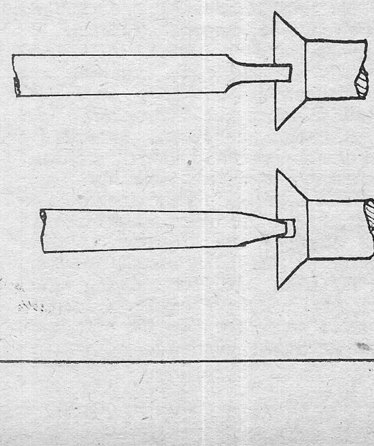


FIG. 4.

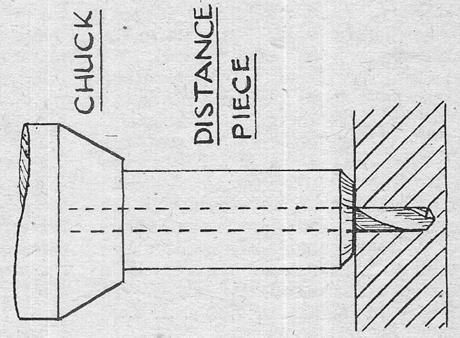


FIG. 5.

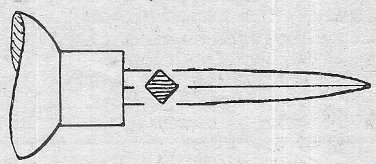


FIG. 6.

SIZE OF SCREW	CLEARANCE SIZE	CORE SIZE
0	1/16"	No. 55
2	5/64"	No. 54
4	7/64"	5/64"
6	9/64"	3/32"
8	11/64"	7/64"
10	13/64"	1/8"
12	15/64"	9/64"
14	17/64"	5/32"

FIG. 7.

For this purpose a rose bit may be obtained which will cut metal as well as wood, and which will fit in the chuck of the hand-drill. In passing, I recommend the use of a hand-drill instead of the carpenter's brace and bit, for drilling the small holes required for screws.

Everyone is familiar with the round-headed screw, and the raised-head (sometimes called "oval-head") type is fairly common, too. This latter kind requires a countersunk hole. Another kind used for its decorative effect has the usual screwdriver slot, but the head is also tapped centrally, and a hemi-spherical head (usually plated) is screwed on by finger-pressure after the screw itself has been driven home in the usual way (see Fig. 3).

The coach-screw is also well-known, with its square head to take a spanner; with this larger type is is imperative that the correct clearance and core-size holes be bored before insertion.

Mention has been made earlier of "a suitably-shaped screwdriver," which is very desirable; many screwdrivers, as bought, are too wedge-shaped. (See Fig. 4.) Where the edge is so shaped, it may be filed or ground up as shown, and a great difference will be found in efficiency. The screwdriver should be chosen to fit the slot in the screw-head fairly tightly, which will make it less liable to slip out and burr the slot or itself.

When drilling for a number of screws of the same size, it may pay to drill a hole through a piece of wood of suitable length, so that it will act as a depth-gauge. This is particularly useful when the holes being drilled are nearly as deep as the wood is thick (say $\frac{7}{8}$ in. holes in 1 in. thick wood.) See Fig. 5.

For the quick insertion of screws up to, say, $1\frac{1}{4}$ in. × 8's, in *soft* wood, I keep an awl of pointed square section (see Fig. 6), which makes a hole quickly and easily, but does not give maximum strength of grip. It is not used in hardwood, since it does not give correct clearance, and the screw would have to be forced, with deleterious effect on the slot.

A rusted-in screw which it is desired to extract may usually be started by holding a red-hot poker to its head for a minute or so; the expansion of the metal will break the rust contact, allowing the screw's easy withdrawal. Another method is to place a stout screwdriver in position in the slot, and give it a smart blow with a hammer. This will drive the screw slightly farther, thus breaking the rust contact as before.

Where it is known beforehand that a screw will need to be withdrawn later, if it be rubbed with soap, tallow, or a candle-end, this will make the subsequent extraction easier.

Brass screws should be used in oak, as the tannic acid contained in that wood will attack iron ones, with results which can be imagined.

Model Submarine Competition Result

(*Continued from page* 297)

with really watertight seals and quick closing devices will suffice. One design had cleverly arranged flange joints with recessed bolts, giving a flush exterior.

Three competitors realised that an excellent method of securing a large apparent difference between surfaced and submerged displacements was to use deck casings and bridge structures almost wholly open to the sea and hence contributing very little to buoyancy. A small pillar of cork bath mat arranged vertically in the conning tower can be made to show a 4 in. change of draught for but 2 oz. change of displacement. Such a dodge ensures that in F.P.B. boats little effort is needed to achieve submergence from a surface condition in which bridge and deck might be habitable.

Retractable periscopes that float up when the vessel submerges, and down when she surfaces, were an ingeniously simple feature of one design.

Controlled steering whereby a pre-arranged course is followed is a distinct advantage for small submarines, and appeared in several designs. Usually it was cam actuated, and associated with the same mechanism in F.P.B. boats as served to move the hydroplanes. In some instances, helm angle was altered by solenoids, and one designer had cleverly arranged that the necessary sequence switches were operated by a disc type removable cam unit, so that the entire programme of manoeuvre could be altered by changing the "record" with a special hatch for access. In general, however, solenoids are far from ideal for steering since the action is too jerky. Permanent magnet motors have more scope for this job and both weigh less and need less current.

Torpedoes were popular, though not essential for this competition. Their projection was usually by spring plungers on the pop-gun principle, but it would be worth while housing the plungers and springs, when in the cocked position, in a sealed tube, and thus avoid further glands and leakage points. Torpedo release, unless electric, inevitably spells glands of sorts. Torpedo propulsion was usually by rubber driven screws, but one design has, perhaps, anticipated history, by employing jet propulsion derived from the electric ignition of a powder charge contained in the body of the fish, which is provided with a suitably shaped vent at the after end.

Unused Possibilities

A useful alternative pressure sensitive device for hydrostatic control of depths in electric boats is the simple manometric U-tube in glass, having one leg connected to the sea and the other open to the hull atmosphere. Using mercury in the tube and a few contact wires sealed into the glass at different levels, a hydroplane motor can be readily controlled. Mercury being thirteen times heavier than water, a 1 in. difference of level corresponds to a pressure of 13 in. of water. Depth adjustment for a given voyage is simple to alter, involving only a change of connections to working contacts. A contact corresponding to maximum permissible depth can readily be made to operate emergency measures to bring the boat to the surface or to release a salvage float. This latter is a most valuable feature when unexpected things happen, and there are some terrible underwater obstructions in our inland "seas" these days!

An Inventor's Model

By J. J. ARMSTRONG

TO BE OR NOT TO BE A Steam Engine—A Water Pump? That was the Question

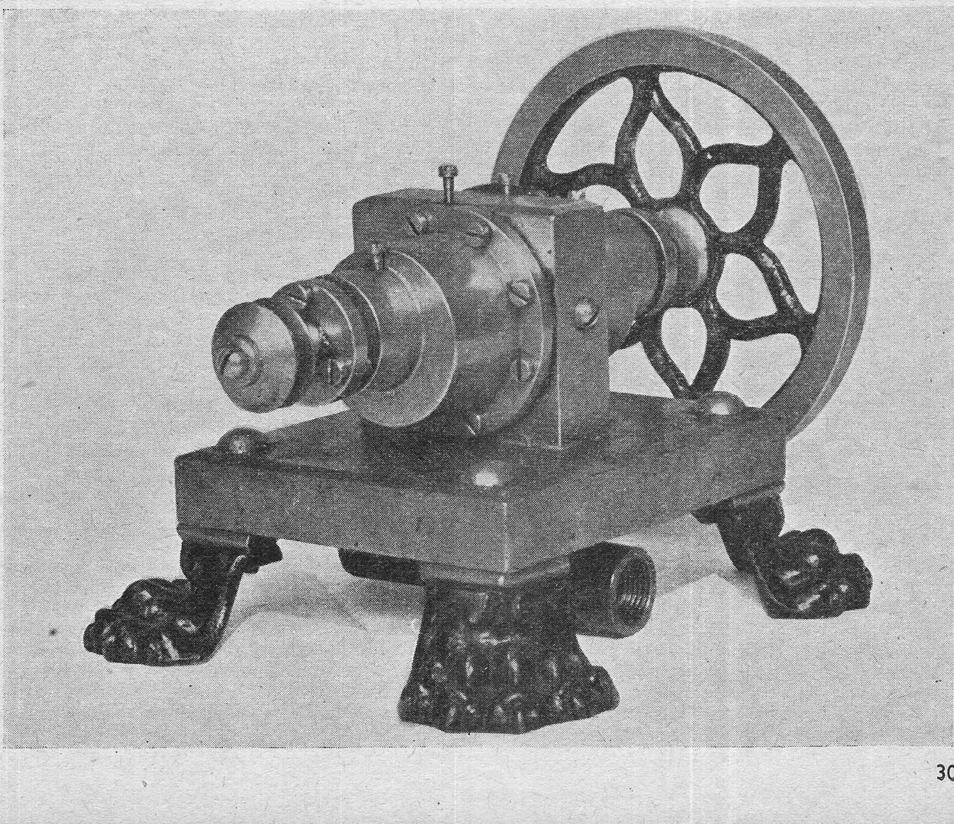
IF you had been present in a little workshop in "Hexhamshire," in August, 1864, and heard the brothers George and William Henderson discussing the model illustrated here, you could have correctly answered the above problem.

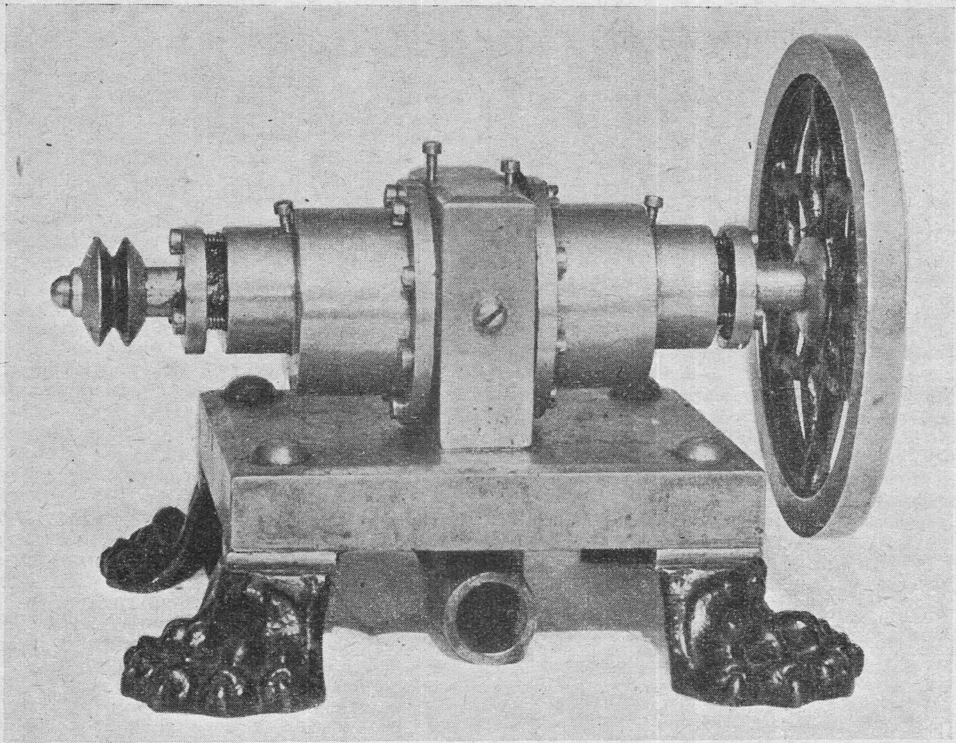
Mr. Armstrong, an enthusiast on antique "plant," baffled a meeting of the Tyneside Society of Model and Experimental Engineers when he brought this model in for examination—the meeting divided into pro-engine members and pro-pumpers.

The photographs show the machine to have a large ornamental flywheel and a small pulley for round belts at the other end of the shaft. Centrally placed is a square chamber with two large pipes (screwed $\frac{3}{4}$ in. gas) leaving the underside, there being two circular but off-centre chambers on either side of the centre chamber—each with a stuffing gland on the shaft carrying pulley and flywheel at its extremities. As will be seen, the whole is mounted on a solid plate supported by four cast-iron feet, each capable of carrying a very much greater weight.

The model was stripped for examination, and in the offset circular chambers it was found that there were two spring-loaded brass blades, driven by or driving, a brass body mounted solidly on the shaft. The same system is used in modern blowers, pumps, superchargers, etc.

During their passage round the cylinders, the blades uncovered ports leading to the central chamber—these ports favoured the supporters of the steam engine theory, as they were almost too small to admit much liquid. On the other hand the timing (or what there was to simulate timing!) seemed impossible, even if the machine was a rotary steam engine—the pros and cons were then about equal.





It should be mentioned that each half of the machine was identical—*i.e.*, there are four sliding blades altogether, two each side. The supporters of the pump theory seized on the huge size of the inlet and outlet pipes as being obviously designed for liquids, but the supporters of the steam engine theory pointed out that it must be an engine on account of the small pulley—if it was a driven pulley it should have been much bigger for any sort of grip—it was obviously a high-speed driver pulley.

And so the discussion went on, and it was decided to have the model steam tested—the steam theory eventually gaining most supporters. The machine was tested at the local colliery (lots of L.P. steam !) and found to be a real steam-eater, but nevertheless, a steam engine, and not a pump. Maximum revs. appeared to be about 150-200 r.p.m.

Subsequently, further information was obtained about this machine which confirmed the tests made. Mr. Armstrong unearthed a solid wooden box, obviously built to carry the model, and on its cover was the legend :—

ROTATORY ENGINE

Invented by George Henderson. Engineer.
Fallowfield, Acomb, Northumberland.
Built by William Henderson. Engineer,
Aug., 1864.
The Iron Works, Hexham, Northumberland.

Local history reveals that George Henderson was an engineer at the old Fallowfield lead mines—near Hexham—where the old engine-beds and waste heaps can still be seen. Flooding and water seepage in the workings was common, and it would seem that the Hendersons tried to evolve a new motive unit for driving pumps. Even in those days it would seem that it was the thing to do to make a model prototype before producing the real thing.

An Old Lathe

Mr. I. P. Carron writes :—" In view of the remarks about old-time machine tools, in ' Smoke Rings ' of February 7th, it may interest some readers to learn of a Whitworth lathe, over 100 years old, which is still in use. I saw it at the Holyhead Motive Power Depot of the L.M.S.R. last summer. The lathe seemed to be in good condition, and appeared to be the only one there.

" Unfortunately, I have no note of the details; but, speaking from memory, the particulars cast on the bed were : J. Whitworth and Co., Manchester. No. 48. 1842.

" The centre-height would probably be about 9 in. I know nothing of its history and am not in a position to find out anything more about it. However, I expect it is still there should anybody with a knowledge of old machine tools want to see it."

Clubs

The Society of Model and Experimental Engineers

There will be a meeting of the society on Tuesday, March 26th, at 6.0 p.m., when a talk will be given by Mr. L. H. Sparey on "A Successful Compression-ignition Model." This will be introduced by Mr. J. Latta, who will outline the problems of compression-ignition as applied to models.

This meeting will be held at 39, Victoria Street, Westminster, S.W.1.

An informal stationary engine meeting will be held at St. Peter's School, Gt. Windmill Street, Piccadilly Circus, at 2.30 p.m., on Saturday, March 23rd. Members wishing to try out steam or I.C. models should bring them along on this occasion.

A Rummage Sale will be held at the workshop on Saturday, April 6th, commencing at 2.30 p.m. This will be a private sale and only members may bid, but visitors are welcome to the two former meetings.

Full particulars of the society may be obtained from the Secretary: J. J. PACEY, 69, Chandos Avenue, Whetstone, N.20.

The City of Bradford Society of Model and Experimental Engineers

The next meeting will be held on March 21st, Thursday evening, 7.30 p.m., at the Gladstone Club.

"Work in Progress" meeting. The system of points has been altered; two points are awarded to everyone who brings a piece of work, and the rule about eight, six and four points has been abolished.

Hon. Secretary: W. WOOD, 274, Hunsworth Lane, Cleckheaton.

Burnley and District Society of Model Engineers

The next meeting will be held at The Church Institute, Manchester Road, Burnley, at 7.30 p.m., on Friday, March 22nd.

Mr. F. Westerman gave a very interesting talk on pattern making and moulding at the last Burnley meeting, and I think all members present enjoyed it, and learned a lot by it.

Hon. Joint Secretaries: J. D. MEE, 2, Windsor Avenue, Church, near Accrington, and A. BATEY, 36, Moseley Road, Burnley.

Tees-side Model Engineering Society

There are probably many model engineers in this district, and it has been decided that a model engineering society is needed.

Would all interested in the formation of such a society please communicate with J. W. WHITTON, 21, Chester Street, Middlesbrough, or W. BIRD, 1, Megarth Road, Middlesbrough.

South London Model Engineering Society

On Sunday, April 7th, the annual general meeting will be held, at King's College Sports Ground, Dog Kennel Hill, East Dulwich, S.E., at 11 a.m. Members are requested to make a special effort to attend. Club officers for the year will be elected and the treasurer's report submitted.

The party of twelve members is now complete for the all-day visit to the Great Western locomotive works, at Swindon, on Wednesday, March 27th.

The meeting for Wednesday, April 10th, at 7.30 p.m., will be ten-minute talks by various members on model engineering subjects.

Particulars of membership and invitation to meeting will be supplied on application to: Hon. Secretary: W. R. COOK, 103, Engleheart Road, Catford, S.E.6.

Coventry Society Model and Experimental Engineers

The meeting held on Friday, March 1st, was a night at the "pictures," provided by Mr. Churcher's sub-standard talkie projector, which he has recently completed. A discussion on I.C. Engines is planned for Friday, March 29th, at 6.45 p.m. Meetings are held in the ground floor room of John Hough's Mission, New Buildings, every fortnight.

Hon. Secretary: J. F. BACK, 3, Macaulay Road, Stoke, Coventry.

The Godalming and District Society of Model Engineers

The second anniversary dinner took place on February 23rd, at which the awards gained at our club show were presented to the successful competitors.

Meetings are held at the Broadwater Hotel, Meadrow, Farncombe, on the first Sunday at 3.0 p.m., and third Wednesday, at 7.30 p.m., of each month.

Hon. Secretary: J. BOURREL, Surrey House, High Street, Cranleigh.

Blackpool Society of Model Engineers

At the first annual general meeting, held at The Railway Hotel, on March 4th, sixteen members were enrolled, five of whom were strangers who had seen the notice in THE MODEL ENGINEER. The response to my sending out a number of circulars and a notice in the local paper was rather disappointing, but we hope that membership will increase in the near future.

Our next meeting will be held on Monday, April 8th, 1946, at 8 p.m., at The Railway Hotel, in which all members are bringing some of their own models for a private exhibition.

Hon. Secretary: CHARLES BAND, 220, Caunce Street, Blackpool.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Maidenhead, Berks.

"THE MODEL ENGINEER"

SALES AND WANTS

Private: **Threepence** *word*. *Trade*: **Sixpence** *word*. *Use of Box* **2/6** *extra*. *Minimum charge*, **3/-**

TOOLS & WORKSHOP

Buck and Ryan's Department for Lathes, Drilling Machines, Grinders, Electric Tools, Chucks, Surface Plates, Lathe Accessories and Tools.—310-312, Euston Road, London, N.W.1. Telephone: EUSton 4661. Hours of Business: 8.30 to 5.0 p.m., Monday to Friday; Saturday, 1.0 p.m.

Silver Steel Rounds, Squares, Asbestos Sheet, String, B.M. Steel Rounds, Squares, Angles, Flats, Brass Rounds, Squares, Flats, Hexagons, Sheets, Copper Tubes, Rounds, Squares, Sheets, Screws, Nuts, Drills, Taps, Dies, Rivets. S.A.E. for lists.—S. REED & SON, 89, Keresley Road, Coventry.

Copper Tube for Boilers, $\frac{3}{8}$", $\frac{1}{2}$", $\frac{3}{4}$", 2", $2\frac{1}{2}$", 3", $3\frac{1}{2}$", $4\frac{1}{2}$", and 6" 20-g. to 14-g. $\frac{1}{4}$" square copper rod, round copper rod all sizes, steel angles, $\frac{1}{2}$", $\frac{3}{4}$" and 1"; bright steel for frames, 1/16th, 3/32", and $\frac{1}{8}$" thick, 2" to 4" in width. Unlimited quantities of the above cut to your length. 5 c.c. aero engine castings and blue prints, 25s. per set. 10 c.c. aero engine castings and blue prints, 35s. per set. All supplies for the model engineer.—BROADWAY (BRISTOL) ENGINEERING Co., Wellington Hill West, Bristol 9.

Split Chucks for Watchmakers Lathes, 6 mm., $6\frac{1}{2}$ mm., and 8 mm., at 6s. each, postage 6d.—JOHN MORRIS, 64, Clerkenwell Road, London, E.C.1

Instrument Maker Clearing Shop. Used and unused H.S.S. drills, taps, reamers, counterbores, countersinks, milling tools, drill stands, mandrels, dial gauge, limit plug gauges, centre drills, lathe cutters, micrometers, etc. All very cheap and subject approval. S.A.E. for full list.—Box No. 3877, MODEL ENGINEER Offices.

Wanted, Small Jig Saw, or Band Saw, or Fretsaw Machine, motorised for lighting power.—GLOVER, 2, Norwood Avenue, Lowton St. Mary's, Nr. Warrington.

Wanted, Myford Bench Lathe, $3\frac{1}{2}$" or $3\frac{1}{8}$" motorised, must be good working order.—SHERIDAN, 50, Manor Drive, Esher. Tel., Emberbrook 1596.

Surplus Machines, Cincinatti 1943 Horizontal Miller. Cost £600. £275. Pallas Toolroom Miller, £95; Surface Grinder, £87; Ward Capstan, £85; Herbert Capstan, £145; Brown & Sharpe Universal Grinder, £125; large special purpose Miller, £55. Also Capstans and Lathes.—VICTA ENGINEERING Co., 32a, Watford Road, Kings Norton.

Copper Sheets, 16-g., 5s. 9d. sq. ft.; Silver Solder, 2s. 3d. ounce; 4, 5, 6, 7, 8 B.A. Screws, 2s. gross; 10 B.A. Brass Nuts, Screws, 2s. 6d.; Steel Nuts, 4, 5, 6, 3s.; 7, 3s. 6d.; 8, 4s. gross; Rustless Balls, Rods, Brass B/M. Angles, Washers. All materials. Send for lists, samples.—REEVES, 81, Cole Valley Road, Birmingham 28.

For Sale, $2\frac{1}{2}$" Centre Lathe, 2 ft. bed with treadle, £8; 1 box of Little Giant Taps and Dies, N.F. and N.C., 1/16"-$\frac{1}{2}$", dies adjustable, brand new, bargain, £6; $\frac{1}{4}$ h.p. Motor A.C., single phase, £3; Transformer and 12 volt Motor, £2. Postage extra.—Box No. 3936, MODEL ENGINEER Offices.

Wanted, by Invalid, Watchmakers or small Precision Lathe (with treadle preferred). Good condition essential. Cash paid, or exchange Corona Portable Typewriter. Guaranteed as new. Will collect in Lancashire. Genuine appeal.—Box No. 3938, MODEL ENGINEER Offices.

Lathes. Build your own Toy and Model Maker's Lathe from easily obtainable parts *only* (costing about 50s.). Set of clear diagrams (6) and instructions for making all parts easily—including alternative types of chuck, headstock, etc. No machining needed. Price 3s. 3d.—M. BARHAM, La Hougue, Vale, Guernsey, C.I. (posted promptly).

Wanted, Super Adept, 2" Wade, or similar small Lathe. Full particulars and price to—MOON, 53, Freegrove Road, London, N.7.

Wanted, 3" or $3\frac{1}{2}$" B.G.S.C. Lathe, with treadle, chucks, tools, etc. Particulars and price to—G. MCEWEN, 15, St. Michael Street, Dumfries.

Vernier Caliper, 10", E. & M. new, also Height Gauge, B. & S., 10" E. & M., excellent condition. Offers please. S.A.E.—WILLIAMS, 28, Birkdale Road, Ealing, London, W.5. PERivale 6917.

For Sale, 3" Super Zyto Screwcutting Lathe with countershaft, pulleys, chucks, change wheels.—DENTON, 29, Fifth Avenue, Bolton.

$2\frac{1}{2}$" "Exe" Screwcutting Treadle Lathe, 16" between centres, 3" chuck, drilling attachment, £28.—H. C. TERRY, 31, St. Johns Wood Road, N.W.8.

Wanted, Boring Bar, suitable car cylinders; also small Lathe.—W. PRICE, Garden House, Cardiff Road, Dinas Powis, Glam.

A Planer Wanted, belt drive preferred, auto traverse, table approx. 18 × 7 × 6. Full details, condition and price.—BARNARD, 20, The Grove, Carmarthen.

Wanted, Shaper, about 8" stroke, in good condition. Power drive preferred.—DAY, 15, High Street, Boston, Lincs.

Surplus Machine Tools. 1943. Pederson all-geared Miller, £195; Colchester 6" Lathe, £90; $4\frac{1}{2}$" Toolroom Lathe, £75; Reed Prentice 8" all-geared Lathe, £130; 6" American Lathe, £45; geared head motorised $6\frac{1}{2}$" Lathe, £175; Milwaukee all-geared Miller, £150; Radial Drill, £95; Herbert geared Capstan, £75; 4 Spindle Drill, £25; Vertical Millers, £40 to £95; Surface Grinder, Ward 1A motorised Capstan, £135; Ward 2 Capstan, £75; Warner & Swasey combination Turret Lathe, geared head, $2\frac{1}{2}$" H/S., £85; Atlas Bench Lathe, motorised, £65; also Bench Drills, Capstans, Grinders, Shapers. Seen any time (including week-ends).—VICTA ENGINEERING Co., Maidenhead. 'Phone 50.

Wanted, Small Circular Sawbench.—13, Beverley Road, Worcester Park, Surrey.

Wanted, 2" Screwcutting Treadle Lathe, £10, age and particulars.—P. HARGREAVES, 6, Buckle Lane, Normanton, Yorks.

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Building "Hielan' Lassie"? Materials from—MAXTED, Central, Chatham Street, Ramsgate.

Guaranteed Gun-metal Cylinder Castings for "Ada" and "Petrolea." Also hornblocks in stock. Wheel castings shortly. Enquiries to—4, Northview Drive, Woodford Green, Essex.

Stuart "Star" Engine, with Twin-Drum Major Boiler, Pressure Gauge, Blow-lamp, also Spirit Burner; pre-war, £7 3s. Offers.—Box No. 3930, MODEL ENGINEER Offices.

Complete Engines for 30"-36" Boats, less boiler, with free detailed blueprint of boiler and controlled spirit burner, few only. Enquiries. S.A.E.—HUGHES, 87, Hopedale Road, Frecheville, Sheffield.

Boat-Fans, 30"-54". Send for leaflets of steam engine castings and blueprints, designed by boat-fan.—HUGHES, 87, Hopedale Road, Frecheville, Sheffield.

"Hielan' Lassie." Main frames cut out, drill spotted ready for finish dressing and drilling through, 25s. pair; Trailing Frames, ditto and bent, 17s. pair, carriage paid. Finished Buffer Beams, 4s.; Drag Beams, 2s.; Bogie Bolsters, 1s. 3d.; Pump Stays, 1s.; Hornblock Castings, 1s. 6d. each.—REEVES, 81, Cole Valley Road, Birmingham 28.

For Sale, Stuart Turner No. 3 Compound Model Steam Engine with reversing gear. Engine erected but slide valves require fitting to complete a beautiful carefully built model. All parts available. Price £30, or near offer.—ADAMS, Pine Tree Drive, West Kirby, Cheshire.

Sale, Steam Engine, $2\frac{1}{2}$" bore L.P., $1\frac{1}{2}$" bore H.P., compound vertical marine type; also set castings for Atom V. Petrol Engine, complete with all data for building. Sold as a whole, £9 10s., or would exchange for smaller engine under 10 c.c.—343, Middlemarch Road, Radford, Coventry, Warwickshire.

For Sale, Lowko Track (tinplate on wooden sleepers), 34 ft. straights, 18 ft. curves, 11 points, 2 crossovers, quantity of rails, wooden sleepers and metal chairs, also wood turntable. The lot £5.—ALLAN, 25, Essex Road, South Woodford, E.18.

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Bassett-Lowke Metre Speed Boat Hull, with petrol blowlamp, boiler, engine, propeller and shaft. Engine needs overhaul. Two Steam Locomotives, one clockwork. Seen London. Offers.—Box No. 3935, MODEL ENGINEER Offices.

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Displacement Lubricator, 10s.; Locomotive Safety Valve, 5s. 3d.; 3/16" Check Valve, 6s.—THOMAS MCCRACKEN, 388, Main Street, Rutherglen.

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White Steam Car Engine wanted.—POYSER, Bramcote, Nottingham.

54" Petrol Model, complete with new Ohlsson "19," £20; Cloud "Elf" Airframe, £5. New motors and accessories. Lists 2d.—SAUNDERS, 7, Granville Park, Lewisham, London, S.E.13.

Sale, Motor Launch Hull with fitted prop. shaft, 36" long × $5\frac{1}{2}$" beam, £3; set of Blueprints for working model, 20 ft. to 1" H.M.S. *Hood*, 10s.; print for model "Great Republic" tea clipper, 5s.—Box No. 3944, MODEL ENGINEER Offices.

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Hornby Electric Set, Gauge "O," 12 ft. steel track, 6 ft. curve, 3 points, and extra track. Transformer control, automatic stop-start and cut-out. Express Engine, 3 long Passenger Coaches, 6 Goods. Offers to—SHAW, St. Paul's, Wokingham.

Wanted, 6 Solid Rubber Toy Tyres, 1" to $1\frac{1}{2}$" diameter.—MUMFORD, 673, Filton Avenue, Filton, Bristol.

Four Cylinder, 5" gauge 'Great Bear' 4-6-2 G.W.R. Locomotive, coal-fired, fully equipped, splendid passenger hauling model; also 5' 6" steam driven Destroyer, blowlamp fired, detailed equipment, realistic working model. S.A.E.—174, King's Road, Westcliff-on-Sea, Essex.

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Castings in Cast Iron and Gunmetal, $\frac{1}{2}$", 1", and $1\frac{1}{2}$" scale Hornsheets; 1" Wheels and Axleboxes; $1\frac{1}{2}$" scale Wheels, $1\frac{1}{2}$" scale Slide Valve Cylinders, with ports cast in; other castings in 1" and $1\frac{1}{2}$" scale. S.A.E. for particulars and prices.—J. M. SWINDELLS, 42, Morton Road, Mexborough, Yorkshire.

Gas Engine Wanted, about $\frac{3}{4}$ h.p., running order. Particulars and price to—BULBICK, "Wayfield," Hazeley Road, Twyford, Winchester.

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Brand New A.C. Motors, 200/250 volts, high starting torque, $\frac{1}{4}$ h.p., £5; 1/3 h.p., £5 10s. All sizes available.—JOHN STEEL, Bingley, Yorks.

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Transformers, 3 K.W. Crypto, 230 volts to 115 volts, 28 amps., £9 10s., to small Bell Transformers, 230/3/58 volts, 7s. 6d. Transformers for Rewind, 3 K.W. with stampings $4\frac{1}{2}$" × 6" × $7\frac{1}{2}$", windings damaged by blitz, weight with damaged wire, 65 lb., 45s., carriage extra.—ELECTRADIX, 214, Queenstown Road, London, S.W.8.

A.C. Motors, 1/50th h.p. to 10 h.p., from stock; also D.C.—JOHNSON ENGINEERING, 86, Great Portland Street, London, W.1. Museum 6373.

A Limited Number of sturdy 1/3 h.p. Electric Motors, mounted on stout frame and supplied with driving pulley. Can be supplied either 12 volt or mains A.C. 1,700/2,000 revs. Ideal for driving small tools, pumps, etc. Size $6\frac{1}{2}$" high, $6\frac{1}{4}$" wide, $11\frac{1}{4}$" long, weight 35 lb., £4, carriage paid, purchaser's risk.—WARD, Anchor Cottage, Shepperton, Middlesex.

1/50th H.P. A.C./D.C. Electric Motors, designed for driving models, fans, moving display signs, etc. Runs off from one to six flat flash lamp batteries in series, according to power required, or a bell transformer connected to mains. Send 25s., plus 7d. postage to—BCM/EDUCATOR, London, W.C.1. Constructional Sets to build the above motors with illustrated, non-technical educational literature and instructions, 21s., plus 7d. postage.

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Watch and Clock Making. If interested you can get all tools and parts also wheels cut from—JOHN MORRIS, 64, Clerkenwell Road, E.C.1. Regret no posts or lists, only counter service at present.

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Wanted, a clean copy of No. 2310 of MODEL ENGINEER.—MATTHEWS, Anglefield Road, Berkhamsted.

Tool Turning, Experimental and Lathe capacity available for high class work. Enquiries invited.—"PUNTER'S PERFECTIONS," Sea Meads, Smithies Avenue, Sully, Glam.

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For Sale, MODEL ENGINEER and "Practical Electrician," 1933 to 1936 inclusive (unbound), £1 per volume or nearest offer.—232, Frederick Street, Oldham.

Wanted, "Model Engineer," Vol. 6, 7, 8, 10, odd copies purchased. Drummond or similar Hand Shaper, motorised Bench Drill, Precision volt, amp. and milliamp Meters. Condition and price.—Box No. 3929, MODEL ENGINEER Offices.

Urgently Wanted, MODEL ENGINEER, Vol. 86, No. 2145 Vol. 87, Nos. 2157, 2159, 2160, 2171. Must be clean. Good price paid.—163, Stonor Road, Hall Green, Birmingham 28.

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Wanted, a copy of H. Muncaster's "Model Stationary Engines," also Nos (Vol. 74) 1823-1825-1829; (Vol 75), 1843-1835 of the MODEL ENGINEER.—Box No. 3933, MODEL ENGINEER Offices.

Sale, Set 40 Parts Newnes "Aeroplane Maintenance and Operation," as new, 30s.—SEDMAN, "Glendale," Galtres Avenue, Stockton Lane, York.

Wanted, all MODEL ENGINEERS, covering building of "Petrolea."—3, St. John's Road, Dover, Kent.

Exchange B.S.A. .22 Air Rifle, good condition, for lathe or hand shaper.—COSBY, 132, Plantation Road, Leighton Buzzard, Beds.

Wanted, Literature describing "O" gauge Electrical Mechanism Construction, etc., also Wheel Castings.—COLLINS, Wesley Manse, Sapcote, Leicester.

12 Watt Amplifier (no cabinet), 230 A.C., P.P. output, grand tone, almost new, £12; MODEL ENGINEER, Vols. 91, 92, 93, exchange for books or catalogues illustrating Astro-telescopes or Microscopes.—Box No. 3934, MODEL ENGINEER Offices.

For Sale, 200 Copies MODEL ENGINEER, July, 1941 to December, 1945, 1 or 2 missing, best offer secures.—FIELD, 75, Grove Road, Chertsey.

Wanted, Set of Scale or Full Drawings of Merryweather 100' Turntable Ladder. Details and price to—TROWELL, 18, Austerby, Bourne, Lincs.

"Model Engineers" Wanted with articles on building "Southern Maid."—J. H. GARLICK, 1, Buckingham Road, Leyton, E.10.

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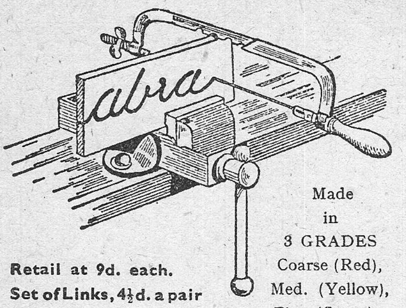

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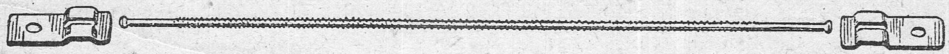

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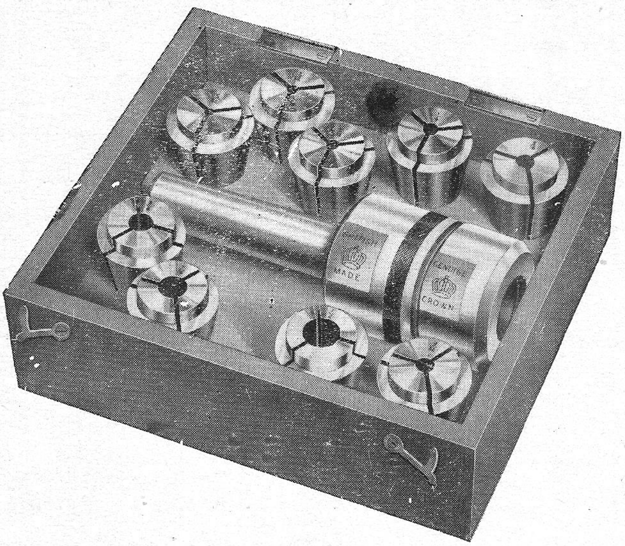

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